The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

MARCH, 1929 VOL. 14, NO. 3

$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. $4.00 per year abroad

They tried 4 makes of welding machines then *Standardized* on WILSON

IN the shop where the accompanying picture was taken A. C. Nielsen Company made an intensive study of welding operations in the repair of locomotives, railway cars, cranes, and other contractors' equipment.

Nielsen reports that, in searching for welding equipment that would meet their extremely varied and highly exacting needs, this shop experimented with four different makes of welding machines. And, although each of the first three machines gave satisfactory service in certain kinds of work, all three makes proved incapable of rapid arc adjustment as they were changed from job to job, and thus caused a considerable loss.

Then a Model S Wilson Welding Machine was purchased. Immediately it demonstrated quicker *adaptability*, closer *control*, greater *portability*, and far greater *strength* in welds than the machines previously used. Its superiority was also reflected in *lower power cost, lower total upkeep, and a tremendous saving in time.* As a result, the company *standardized* on *Wilson* and today, all their welding is done *exclusively* with Wilson Machines.

Regardless of what your industry is, Wilson—with its long and varied experience, with its great accumulation of welding information—can assist you in solving your welding problems.

WILSON WELDER & METALS CO. INC.
20 Wilson Building, Hoboken, N. J.

Wilson Model S Welding Machine at work on a locomotive repair job.

WILSON

WELDING MACHINES AND WELDING WIRE

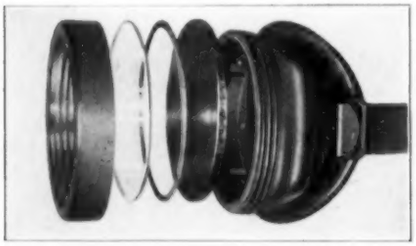
In the repair shop referred to above Wilson "Color-tipt" Welding wire has been used almost *exclusively* for the last five years. This company points out that one of the outstanding advantages of Wilson Wire is that the *right* grade (analysis) can be selected for the *particular metal* being welded.

Trade Mark Reg. U. S. Pat. Off.

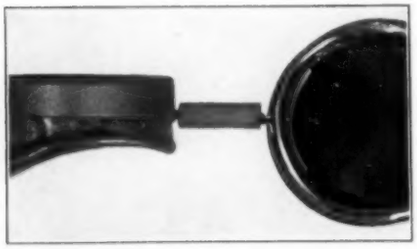
Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

A New Welding Goggle . .

Ventilation—design. In each eyecup vents located at nasal and temporal sides. Full air circulation — yet all openings completely closed to light.



Cleanliness. Lens assembly quickly dismantled for cleaning and replacement of lenses.



Adjusting. A chain bridge permits adjustment to any face, providing a snug comfortable fit. A twist of the fingers adjusts the bridge.

with complete ventilation . . . no light leakage . . . greater durability

Providing the modern welder with greater protection and greater comfort—comes the new Duralite Welding Goggle. It is lighter in weight—easier to keep clean, and more durable.

Study the ventilating design. Two vents, actually designed for intake and outlet, bring cool air to the face. Now notice the way these vents are wide open for air—yet completely closed to light by an inside baffle plate on the nasal side and an outside louver on the temporal side of each eyecup.

Not only in design, but also in materials, Duralite excels. It is strong, non-inflammable, a non-conductor of heat—will not warp or get out of shape. The new A O Noviweld lenses, giving 99.9% protection against infra-red and ultra-violet, are regularly supplied with Duralite Welding Goggles.

Welders actually feel the comfort of Duralite improvements. Duralite is the result of a real step forward in goggle design—it will quickly achieve all the popularity that has always been enjoyed by American Optical Company goggles.

Prices: Duralite Welding Goggle, per pair, $2.50; in quantities 150 or more, $2.25 per pair.

American Optical Company

Safety Division

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Profitable Scrapping with Airco Oxyacetylene Equipment and Gases

Airco Oxyacetylene cutting was adopted in this yard for scrapping. It proved so satisfactory that its use was increased ten-fold during the last three months of 1928.

This is just another case where oxyacetylene welding and cutting has demonstrated its economy and convenience to its users.

Write our nearest office, listed below, for suggestions as to what it can do for you.

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FOR several years past the demand for National Gauges has been so heavy that we have had to increase our production facilities. In doing so we have been able, without sacrificing one iota of quality, to make these famous welding gauges at a very low cost.

The prices of Natweld Gauges today make them the truly economical buy.

Don't forget that materials and workmanship are of the very best; that these gauges have the unqualified approval of the Underwriters Laboratories; and that the welders themselves prefer them.

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The Welding Engineer

Founded by L. B. Mackenzie, 1916

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ADVERTISING is one of the constructive elements in the organization of modern American Life.

It has brought about a more comfortable standard of living wherein bathtubs, showers, radios, telephones, etc., are common equipment in the American home.

It has educated the buyer to make intelligent selections in the articles for business and home use. It has stimulated the manufacturer toward continuous improvement in his product's quality.

It is an agent of *economy*, distributing over a wide area the selling message of the manufacturer, aiding him to build a wholesale production, and lowering the cost of manufacture and distribution.

Advertising, therefore, is a force of wide utility, operating to the benefit of seller and buyer.

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Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Air Reduction Sales Co.
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International Oxygen Co.
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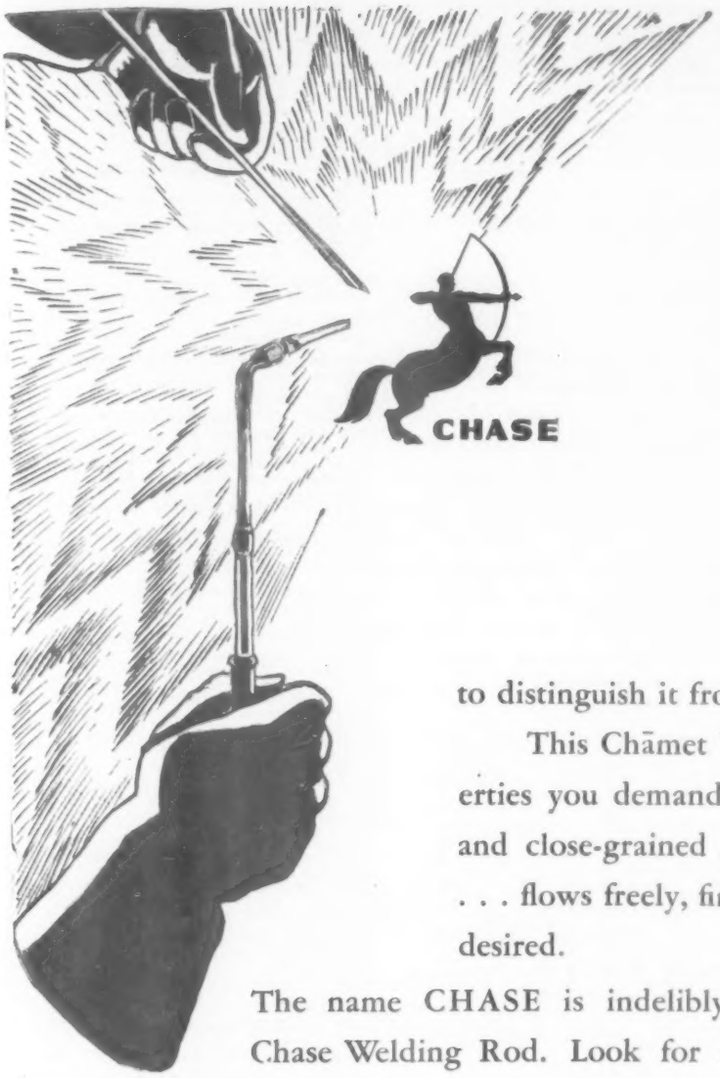

About our Chāmet Bronze Welding Rod . .

Our Chāmet *Bronze Welding Rod is made from our own special mixture of bronze . . . we have named it Chāmet to distinguish it from ordinary kinds of bronze.

This Chāmet Welding Alloy of ours has all the properties you demand in a good welding metal. It is strong and close-grained . . . melts at just the right temperature . . . flows freely, finishes easily . . . will take high polish if desired.

The name CHASE is indelibly stamped on every length of genuine Chase Welding Rod. Look for it—it is your guarantee of a dependable product.

Rush service when you need it . . . With thirteen warehouse stocks throughout the country, Chase is always prepared to give you immediate shipments.

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Chase Chāmet Bronze Welding Rod
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*Details of tensile strength, elasticity and machining properties gladly furnished upon request.

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Torchweld Equipment Co.
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Weldit Acetylene Co.
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See "Electric Resistance Welders"

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See "Electric Resistance Welders"

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You Would Expect It to Cost More—But It Doesn't

ALTHOUGH **SWEDOX** wire represents close supervision and careful checking of analysis, rigid inspection before it is placed in stock as welding wire, and a study of welding wire requirements which dates back to the first days when any attention was paid to the quality of filler material, SWEDOX does not increase your welding costs. This is not because it is a "cheap" line, but because SWEDOX has welding qualities which reduce waste effort and weld failures to a minimum. Welders who started using SWEDOX fifteen years ago have found it profitable to use SWEDOX ever since.

There is a SWEDOX Wire for every type of welding. Let us help you select the one best adapted to your work.

Central Steel & Wire Company

CHICAGO, ILL.
4545 S. Western Blvd.
Lafayette 8500

DAYTON, OHIO
East Monument Ave.
Extended
East 150

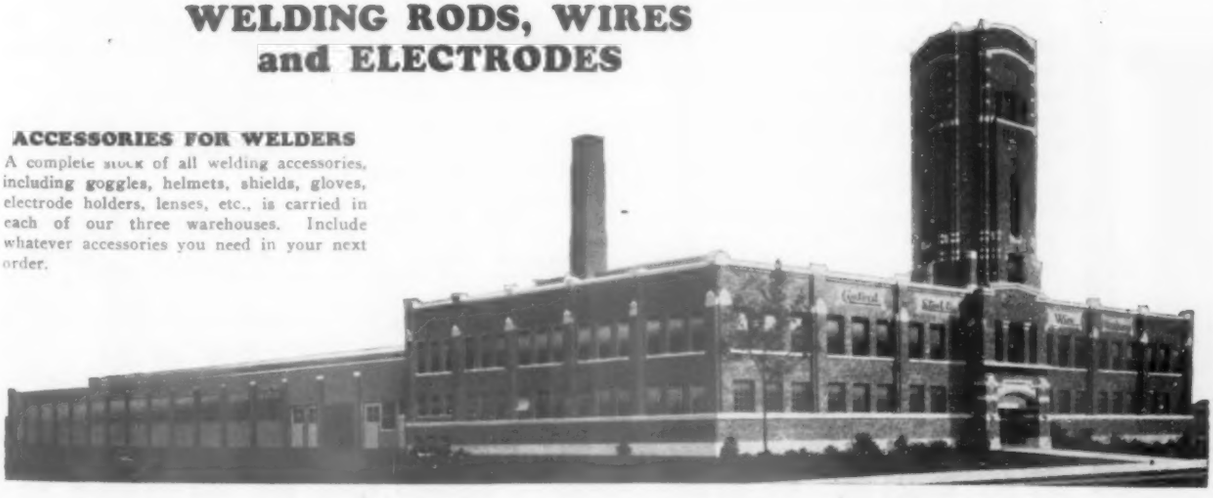
DETROIT, MICH.
5001 Bellevue Ave.
Whittier 6780

SWEDOX

WELDING RODS, WIRES and ELECTRODES

ACCESSORIES FOR WELDERS

A complete stock of all welding accessories, including goggles, helmets, shields, gloves, electrode holders, lenses, etc., is carried in each of our three warehouses. Include whatever accessories you need in your next order.



Main Warehouses and General Offices, Central Steel & Wire Co., Chicago

Lad does the figuring

TRADITION

PROGRESS

"Here, Lad—

what I can't figure out is why a company the size of Lincoln Electric should be the leader in arc welding instead of the much larger companies.
Is there a reason?

"No, Pop—

there are four reasons.
And number one is that Lincoln was FIRST in the field with a commercial arc welder.
Next, their patents enable them to give their machine a wider welding range than any other welder.
Then they have specialized on arc welding and have not branched into various departments of electricity.
And a big factor in their development is in the burning up of red tape in dealing with customers. No matter what's your problem, you get the right answer —promptly.
So that's why they're at the head of the class.
You know how the kid feels when he's kept after school because his father, who has other interests, figured his arithmetic wrong?"

Only "Stable-Arc" Welders have all these features

- Variable Voltage.
- Laminated Magnetic Circuit.
- Separately-excited Generator Field.
- Double Control of Welding Heat.
- Steady Arc Throughout Entire Welding Range.
- All Steel Construction.
- Full Capacity for either Metallic or Carbon Arc Welding.

These features make welding easier. Results—better welds and greater output.

Ask any Operator!

The Lincoln Electric Co., Dept. No. 2-73, Cleveland, O.

"Stable-Arc" LINCOLN WELDER

W-67

"Oxweld carries on when the others quit . . ."

A STUDENT engineer characterizes the above phrase as "my simplest way of expressing the reason for my choice of Oxweld equipment as being superior to others." This young man had just completed his curricular requirement in oxy-acetylene welding and cutting at a prominent engineering school. Ninety-two per cent of his classmates also chose Oxweld.

There is a similar marked preference for Oxweld in industry. The reason is economic. Oxweld blowpipes, embodying the Oxweld low-pressure injector principle, give more welding, more cutting, more hours, months and years of operation. They carry on when the others quit.

Reliable—Economical—Long-Lived
Typically Oxweld

OXWELD
WELDING AND CUTTING APPARATUS AND SUPPLIES

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

NEW YORK
Carbide and Carbon Bldg.

UCC

CHICAGO
Peoples Gas Building

SAN FRANCISCO
Adam Grant Building

STOCKS IN 38 CITIES

This photograph shows the location of Haynes Stellite welding rod. A band approximately ½" wide and 3/64" thick is applied on the top of the cutting edge. The top and bottom sides of the point are also coated with Haynes Stellite welding rod 2" from the extreme point and ⅛" thick.

Long wearing plow shares

HAYNES STELLITED plow shares wear from four to five times as long as regular steel shares and cost less than twice as much.

By the use of the Stelliting process (the application of Haynes Stellite in the form of welding rod to wearing and cutting surfaces) farmers can now procure plow shares that will reduce their cost per acre.

Farm equipment dealers and welding shops—Develop this business with the farmers in your locality. You can apply Haynes Stellite to new and worn solid or soft center steel plow shares in your own shops and render a real service to your customers, with real profit to yourselves.

Write for our pamphlet describing in detail how Haynes Stellite is applied to this important part of the farmer's equipment.

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

DISTRICT SALES OFFICES

Chicago—1949 Peoples Gas Building
Cleveland—628 Keith Building
Detroit—4-240 General Motors Building
Houston—6119 Harrisburg Building
Los Angeles—1310 Santee Street
New York—30 East 42nd Street
San Francisco—114 Sansome Street
Tulsa—Exchange National Bank Building

General Offices—Kokomo, Indiana

Haynes Stellite welding rod is also available from any of the 28 District Sales Offices of Oxweld Acetylene Company

Stelliting with

HAYNES STELLITE

Phantoms of the Past All Remind Us

of "those good old days when—." Observations lead us to the thought that Adam himself was the only man who did not refer to the good old days. Yearning for the past is the surest sign of senility.

Would we give up our fast motor cars for the old family horse and buggy? Our Twentieth Century Limited for the lumbering, coughing old choo-choo that farmers threatened to ditch because its belching smoke blackened the wool of their sheep and frightened their cows? You wouldn't prefer the old covered wagon to present day transports.

There is a fast growing number of welders throughout the country who wouldn't trade their new Xcel Torches and Xcel Line of Welding Tools for all the old equipment they ever used. There is such a difference some have told us they wonder how they ever did get out their work with any speed and ease at all with the old fashioned tools.

You must have tools nowadays that are simple in design, sturdy, but not cumbersome, dependable. And if they are graceful, well balanced, really beautiful in appearance, so much the better. These are qualities built in every Xcel Tool made. Xcel Torches are fashioned of solid bar brass and drilled. This is the reason they are strong, long-lived, and cannot leak. Torches made of tubing cannot boast of these advantages.

Get acquainted with the new Xcel Line. Send for our new catalog. It tells all about the great strides forward made in welding tools. And by the way, there is a lot of valuable information in the book every welder should have at hand, useful facts, tables of pressures, weights and measures, and some mighty fine articles on welding and cutting.

There's a copy for you. Write at once. If you are a welder we want you to have a copy. It's free.

XCEL TRADE MARK THE SUPERIOR OXY-ACETYLENE CO ST. LOUIS, MO

By this Trade Mark you will know a new excellence

The Superior Oxy-Acetylene Co., Inc.
4915 Connecticut Street :-: :-: St. Louis, Missouri

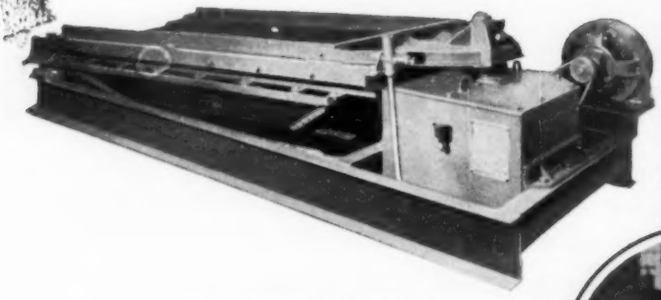
OR

The Kansas Oxy-Acetylene Co., Inc.
402 East 29th Street :-: :-: :-: Wichita, Kansas

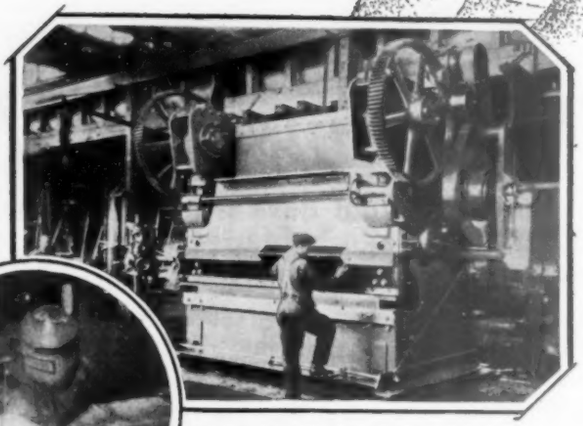
Distributors of Shawinigan Carbide and U. S. L. Arc Welders, welding rods, etc.

Several choice territories are still open for responsible distributors to handle the Xcel Line.

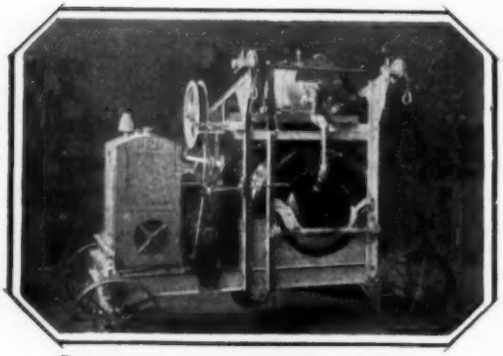
RADICALLY CHANGING The Manufacture of Machinery



Orville Simpson Co. "Rotex" Heavy Duty Screen completely fabricated by arc welding



The Cincinnati Shaper Company has redesigned a line of heavy press brakes to make use of many standard arc welded shapes. These new machines are winning widespread approval



Concrete mixer completely fabricated by arc welding

THE MORE YOU ARC WELD THE MORE YOU SAVE

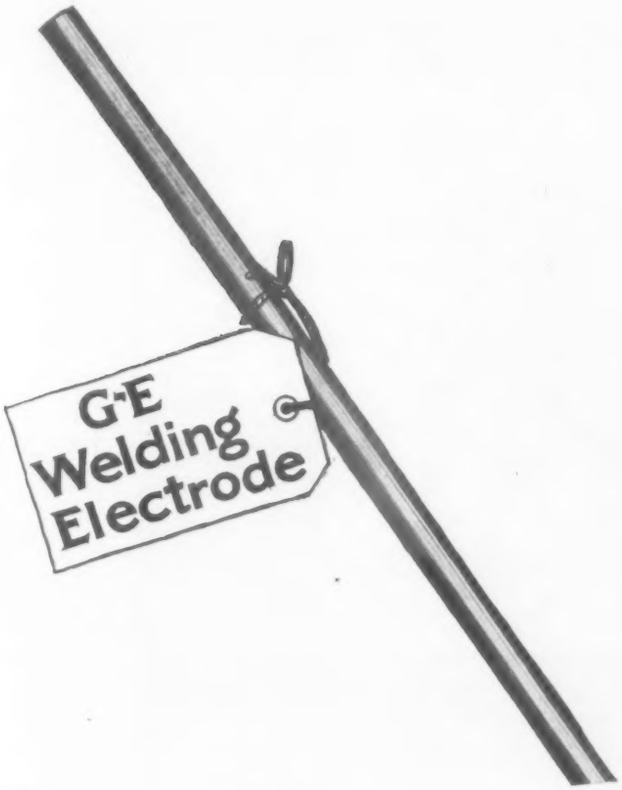
Fabrication by arc welding is one of the most outstanding developments in the history of machine design. Hundreds of small machines are now completely arc welded. Many heavy machine tools are being redesigned to make use of steel plate and of standard shapes fabricated by arc welding. Where machines are made largely to order and in small numbers, castings are being discarded and the machines fabricated by welding at a cost lower than that of patterns alone.

In our own factories, we have made astounding strides in the manufacture of machinery from the very largest waterwheel-driven generators down to the details of small control units. This has brought us a wealth of experience. This experience, the facilities of our developmental laboratories, and a complete line of arc welding equipment are available to you through your nearest G-E office.

530-47

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

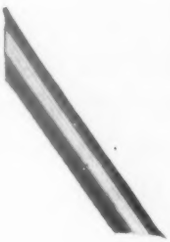


-*for* welds to withstand pressure

A leading utility company recently constructed three 30,000-gallon storage tanks. The 1600 feet of welded seams in each of these huge water bins must withstand tremendous pressures. It is significant that G-E Type "F" welding electrode was chosen for this exacting assignment.

The selection of Type "F" electrode was not a haphazard choice. It had approved itself to this company in the shops and in the field. Whether applied in vertical, horizontal, or overhead positions, the welds have been tough and durable. Whether used for heavy structural steel or pressure pipe-line welding, the unions have been strong and lasting.

For prompt service or additional information as to various types of G-E electrodes, get in touch with the G-E Welding Electrode Distributor near you or write to Section E-533, Merchandise Department, General Electric Company, Bridgeport, Connecticut.



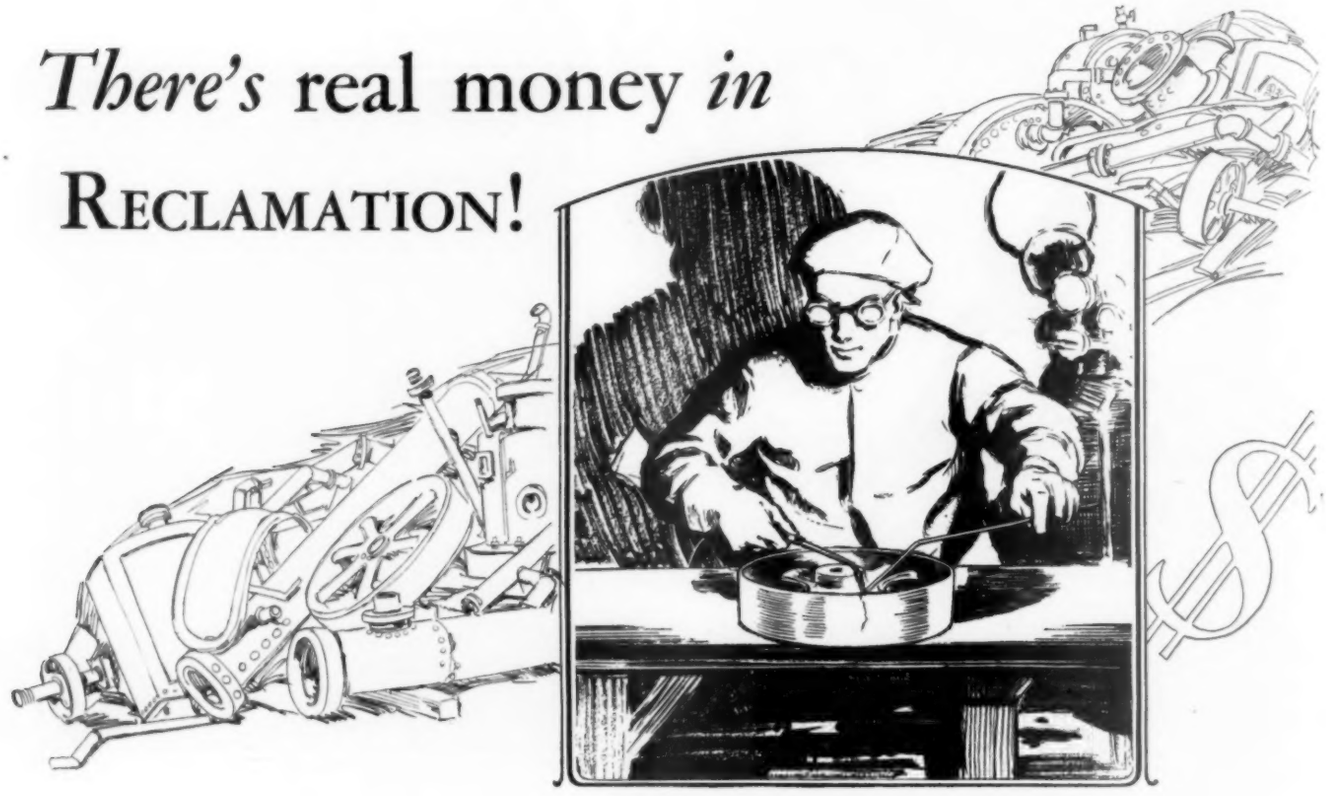
In absolute reliability of operation and over-all efficiency, G-E arc-welding sets are unequalled. They are available in all sizes, all types —for either hand or automatic operation—for one or more operators.

550-509

GENERAL ELECTRIC

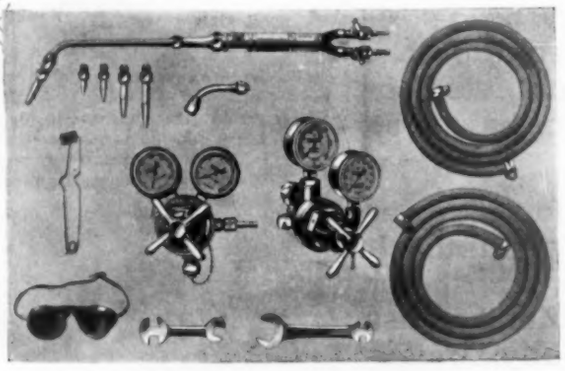
MERCHANDISE DEPARTMENT. BRIDGEPORT. CONNECTICUT

There's real money *in* RECLAMATION!



RECLAMATION of worn and broken metal parts by oxy-acetylene welding is a matter of real dollars. Scrap piles are disappearing. Thousands of operators are making old parts new with Prest-O-Weld. They are building business and making profits.

Take advantage of this! Any good mechanic can readily learn to use Prest-O-Weld, and with reasonable practice can do the average range of welding. The Prest-O-Weld Welding Outfit pays for itself out of earnings in a surprisingly short time.



Prest-O-Weld Welding Outfit
No. W-101 Price $75.00
Other Utility Outfits as low as $49.50

Made by the largest manufacturers of oxy-acetylene apparatus in the World. Sold by jobbers everywhere.

OXWELD ACETYLENE COMPANY . . . *Unit of Union Carbide and Carbon Corporation*

UCC

NEW YORK: Carbide and Carbon Building.
CHICAGO: Railway Exchange Building.
SAN FRANCISCO: Adam Grant Building.

PREST-O-WELD

You Can Bank on Mueller Welding Bronze — and on Mueller Service

YOU will find that Mueller Welding Bronze Rod will give you the same definite result time after time. It has all the qualities that you would expect to find in a real product. It is strong and close grained . . . It melts easily and flows freely. Absence of porosity eliminates sputtering and explosions.

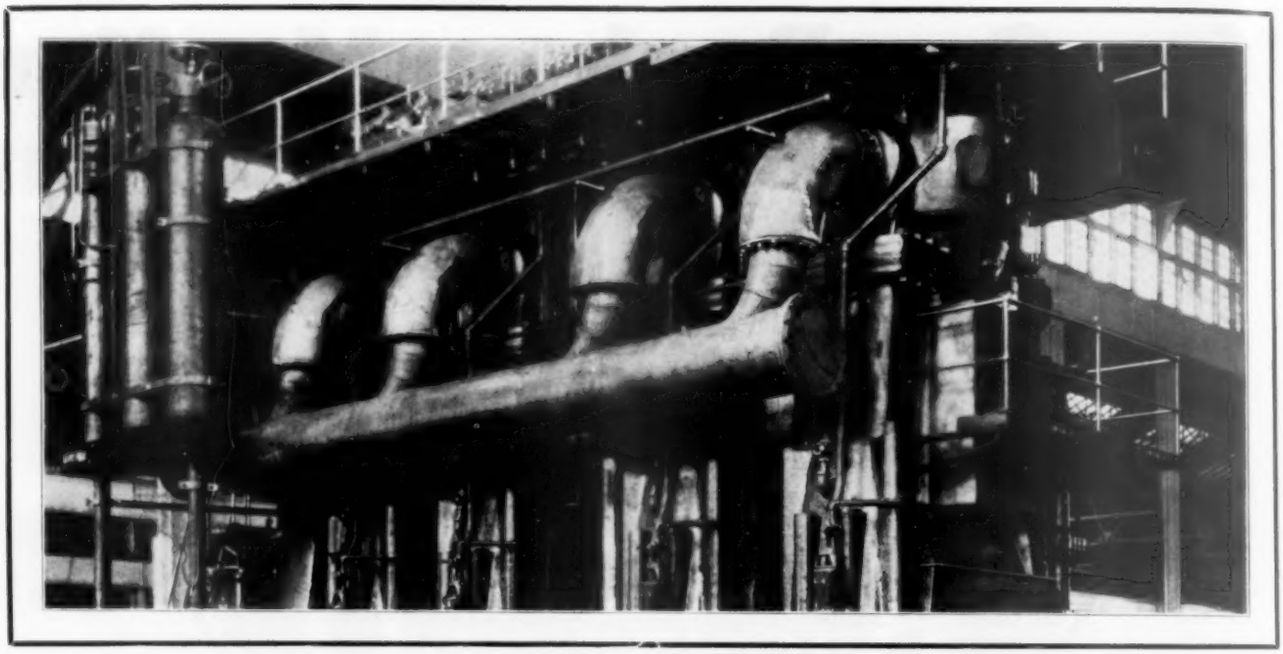
Mueller Welding Rod is distinguished by the wording "Mueller Welding Bronze" stamped every few inches on the rod itself.

For a special job that must machine easily or take a high finish — or for any job — you can depend on it to give you the results you must have.

When you are in a hurry you can depend upon quick delivery, too.

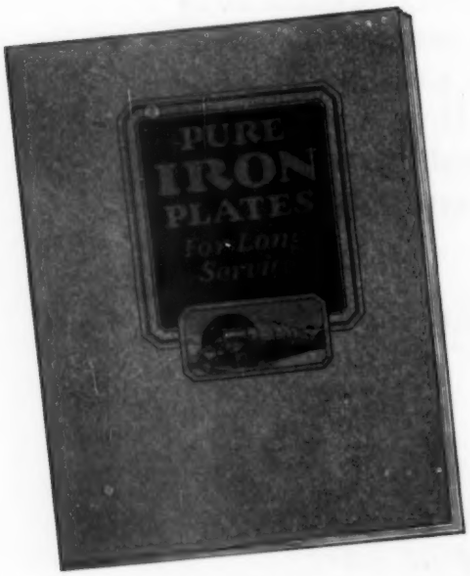
Mueller Brass Co.
PORT HURON MICHIGAN

THREE GENERATIONS OF BRASS MAKING



This exhaust manifold in the Nordberg Manufacturing Company's plant at Milwaukee, Wisconsin, is made of rust-resisting ARMCO Ingot Iron, electrically-welded for strength and permanence.

Bigger Profits for You the PURE IRON Way



"Pure Iron Plates" is filled with good working information on ARMCO Ingot Iron plates, welding rods, electrodes, and other subjects of vital concern to the welder. You'll find this booklet useful in every-day shop practice. Ask for a copy. It costs nothing, and there is no obligation.

WHEN you recommend ARMCO Ingot Iron plates or sheets to your customers you render them a service that is certain to be reflected in more and profitable business as time goes on.

For ARMCO Ingot Iron is made to last. Rust-promoting impurities are purged from the metal by special refining processes. Hundreds of installations everywhere show this pure iron outlasting ordinary iron and steel by extra years of service.

There are shop economies for you, too. Being soft, uniform, and virtually degasified, ARMCO Ingot Iron flows easier and makes sounder welds, whether you use the oxyacetylene, electric arc, or hammer weld method. Appreciable time and labor savings are assured—with better welds.

The office nearest you will be glad to furnish you information on your particular problems. Just write or wire.

ARMCO

THE AMERICAN ROLLING MILL CO.
***Executive Offices,* MIDDLETOWN, OHIO**

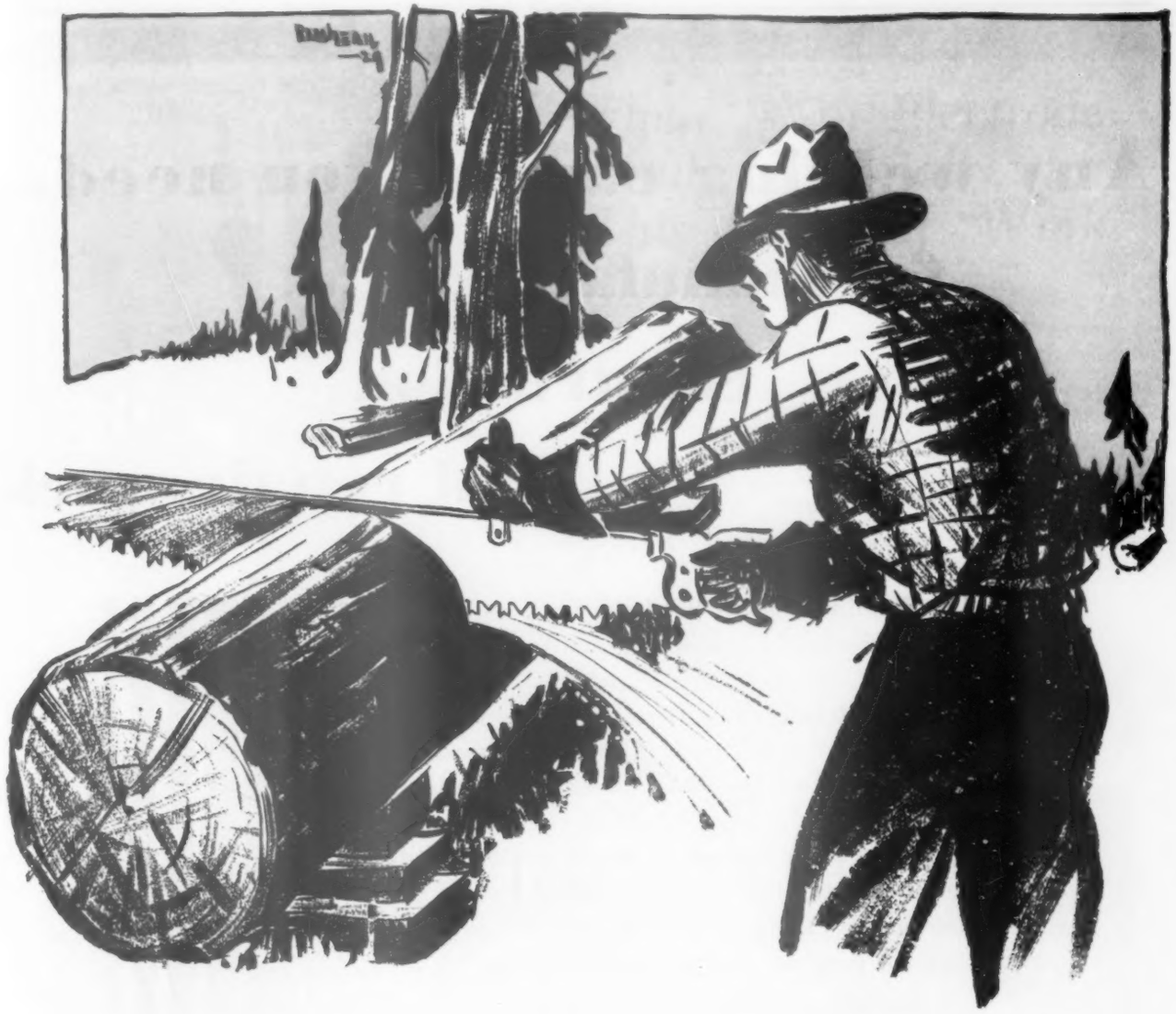
Export:
The ARMCO International Corporation

Cable Address:
ARMCO, Middletown, Ohio

District Offices:

Chicago	Detroit	Pittsburgh
Cincinnati	New York	St. Louis
Cleveland	Philadelphia	San Francisco

ARMCO INGOT IRON RESISTS RUST



BORIUM *Cuts..like a Keen Saw*

OIL WELL drillers need a bit that ***cuts!***... that ***goes through!***... regardless of the formation... and nothing yet has been found so economically efficient as BORIUM.

Both abrasive-resisting metals and cutting materials have their use... and neither can supplant the other.

THE STOODY COMPANY manufactures the outstanding, ***proven*** leaders in both fields... Borium and Stoodite ...and, in oil-well drilling, recommends their ***companionate*** use.

Just as a saw is superior to the ***hardest*** of smooth steel, so is BORIUM superior to any hard-facing metal for cutting...for ***going through***... regardless!

In fact, ***nothing***, other than diamonds, ***can*** do the work of BORIUM.

STOODY COMPANY

Manufacturers of **WELDING ROD • ALLOY STEELS • EQUIPMENT**
WHITTIER, CALIFORNIA

Any welding carbon you need—for manufacturing, construction and repair work

NATIONAL Welding Carbon Products come in a line that is complete in every particular. No matter what kind of welding carbon you want, we can supply it. For welding electrically or with gas. For cutting. For use as electrodes, as cores, as dams. For working with heavy shapes, or thin sheets. These Welding Carbon Products add greatly to the speed, precision and economy of modern welding. In some cases they have made new types of work possible, enabling the welder to accomplish feats previously thought impossible. National Welding Carbon Products are made in carbon, special graphite and graphitized types.

Write for list of our distributors

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division
Cleveland, Ohio

Unit of Union Carbide UCC *and Carbon Corporation*

Branch Sales Offices are located in
Jersey City, N. J. Pittsburgh, Pa. Birmingham, Ala.
Chicago, Ill. San Francisco, Cal.

NATIONAL WELDING CARBON PRODUCTS

BLOCKS
RODS
PASTE
FLOUR
ELECTRODES

KORO Processed Electrodes Have the Distinctive Appearance Shown Below

There Is an Electrode Made Especially for This Class of Work

Automatic Welding of Small Tanks—The job illustrated is a 36-inch tank, 20 inches in diameter. The stock is 10-gauge sheet steel. KORO High Speed Automatic Electrode is on the job. A sound, well penetrated weld is obtained at the rate of 29 inches per minute.

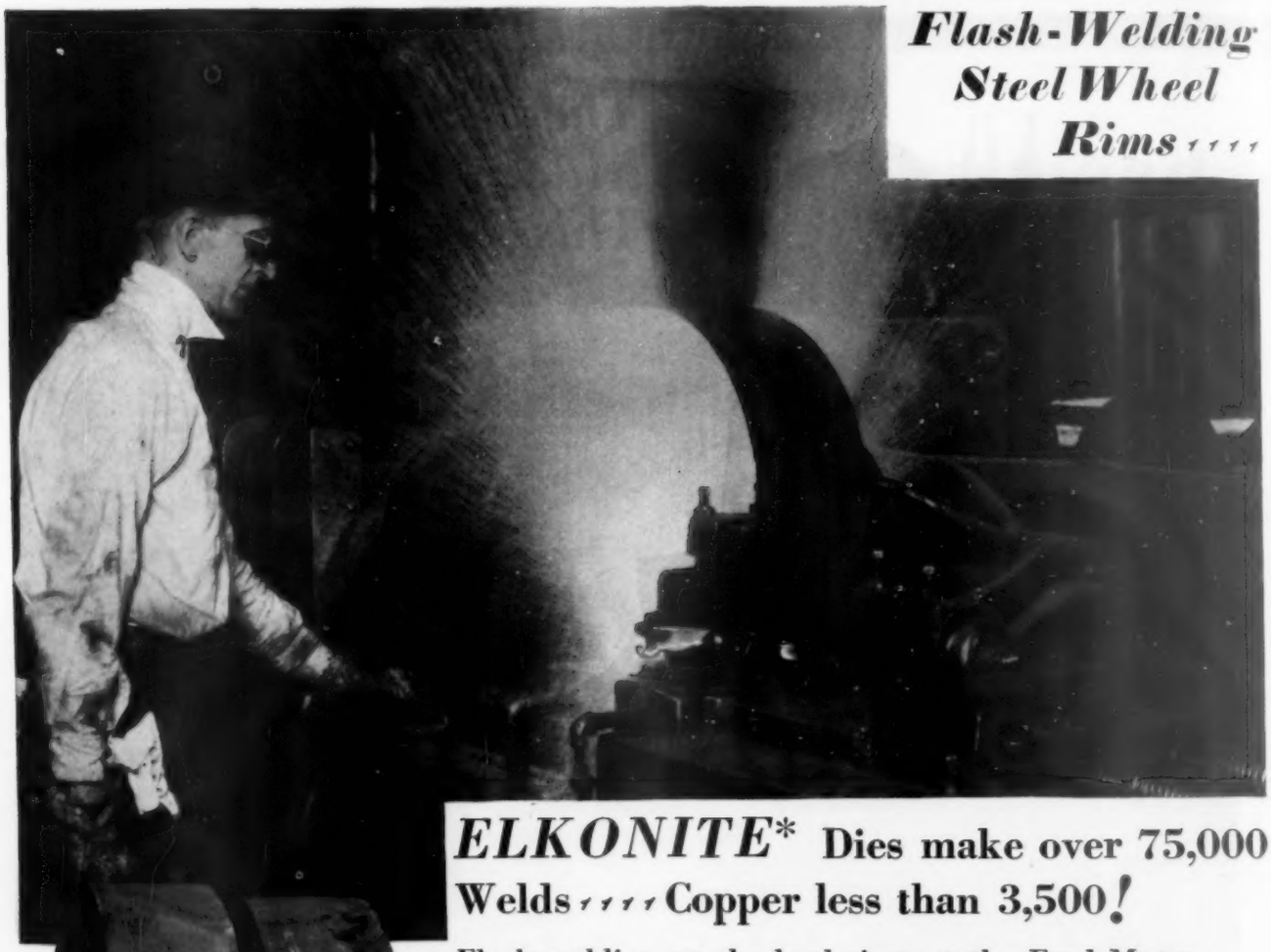
"KORO"
(Patent applied for)
WELDING WIRE

Write for booklet describing the complete KORO line of wire for gas and electric welding

TO GET satisfactory work and a high production rate with automatic arc welding you need a wire "designed specifically for automatic welding." That phrase is an accurate description of KORO High Speed Automatic Electrodes. From the analysis specification through every detail of applying the KORO Process, the requirements of automatic arc welding are met and fulfilled. And these electrodes have met the test so well that tank shops, boiler shops, automobile plants, and other users of automatic arc welding are standardizing on KORO. May we send you a sample order to try out in your plant?

KORO CORPORATION
WAUKEGAN, ILLINOIS
DISTRIBUTORS: CENTRAL STEEL & WIRE CO.
Chicago, Ill.; Detroit, Mich.; Dayton, Ohio.

KORO Processed Electrodes Have the Distinctive Appearance Shown Below



Flash-Welding Steel Wheel Rims ‹‹‹‹

The rim before and after the Elkonite weld. Copper dies on this job made less than 3,500 welds. Elkonite makes *75,000* to *100,000* welds.

*ELKONITE** Dies make over 75,000 Welds ‹‹‹‹ Copper less than 3,500!

Flash-welding steel wheel rims at the Ford Motor Company, Detroit, Mich. Here Elkonite dies again prove their superiority over other welding die material by making from 75,000 to 100,000 welds before replacement is necessary. Former copper dies used made about 3,500 welds!

Elkonite not only lasts from 10 to 80 times longer than copper but makes a *better weld* with *less shrinkage* and speeds up production because it reduces redressing time to a minimum.

The application shown here is only one of many on which Elkonite has paid for itself many times over in reduced labor and material costs and has greatly increased the factory output. Our engineers will be glad to tell you how Elkonite Dies and Electrodes can be applied to your resistance welding operations —no obligation, of course.

*Reg. U. S. Pat. Off.

***ELKON*, Inc. (*Elkonite* Dept.)**
Division P. R. Mallory & Co., Inc.
350 Madison Ave., New York

ELKONITE

REG. U.S. PAT. OFF.

HANDY & HARMAN
FOUNDED 1867
QUALITY SERVICE

STRENGTH!

of

Handy Silver Solder

"Handy" Silver Solders make joints that are usually stronger than the metal parts themselves.

1. *Extruded Bronze*

For instance, two sections of square extruded bronze —butted at the mitre were brazed with Handy ATT silver, under an oxy-acetylene flame. Though the metal is only about $\frac{1}{8}$ in. thick the joint was so strong that it showed no sign of failure when the welded piece was bent, cold, through an arc of 270° as shown in the photographs.

2. *In Wire Drawing*

Wire manufacturers braze successive lengths of heavy copper, brass or other wire rods for drawing cold, to smaller sizes, sometimes to .002 diameter or smaller.

3. *A Huge Copper Still*

A huge 12 ton copper cylinder for an industrial alcohol still 10½x52 ft. in dimensions brazed at all seams with "Handy" Silver Solder, showed neither distortion nor leak under hydrostatic pressure.

4. *In Airplane Construction*

The United States government makes mandatory the use of silver solder for specified purposes in airplane construction. Joints have a tensile strength of 40,000 to 60,000 pounds per square inch.

Twelve Guaranteed Compositions

Are now offered. They range from 80% silver down to 10% and in melting points from 1352°F to 1600°F.

We Co-operate

in determining for you which solder lowest in silver (and hence least expensive) will best serve you. Write fully or send parts to 57 William Street, New York, N. Y.

Other Characteristics

1. Resistance to vibration and shock.
2. Resistance to operating temperatures from 1325°F to 1600°F according to the type of Silver Solder used.
3. Resistance to corrosion from chemicals and weather exposure.
4. High electrical conductivity; silver being even higher than copper.
5. Free-flowing. Extraordinary penetration. An extremely thin film does the work. Joints neat and trim. Low unit cost for both solder and labor.

Metals They Join

Handy silver solders are used for joining all metals fusing at 1400°F or above —including steel, nickel, copper, bronze, brass, silver, extruded bronze and brass, monel metal, stainless steel, etc.

Ask for the "Handy" Book of Silver Solder "W."

HANDY & HARMAN

Executive Offices: 57 WILLIAM STREET, NEW YORK

Plants—Bridgeport, Conn. Providence, R. I. Fulton and Gold Sts., New York City

Pipe Cutting Simplified

Many of the patterns required for cutting pipe to make up welded fittings would take hours of time to develop in the drawing room.

Even the simplest patterns are difficult to make when one is not familiar with the principles of mechanical drawing.

Consequently, welded fittings may be costly to make, due to imperfect cutting.

As a solution of the cutting problem, we have for sale a complete set of full size blue prints of curves, which enable you to cut your connections *correctly and accurately* the *first* time.

THIS SET INCLUDES THE FOLLOWING CONNECTIONS:

PIPE PATTERNS

2" 3 Piece Ell
2" 45° Ell
2" Rt. Angle Ell
2" Lateral
2" Round End
2" Tee

3" 3 Piece Ell
3" 45° Ell
3" Rt. Angle Ell
3" Lateral
3" Round End
3" Tee
3" Y
3" Split Bull Plug

4" 3 Piece Ell
4" 45° Ell
4" Rt. Angle Ell
4" Lateral
4" Round End
4" Tee
4" Y
4" Split Bull Plug

6" 3 Piece Ell
6" 45° Ell
6" Rt. Angle Ell
6" Lateral
6" Round End
6" Tee
6" Y
6" Split Bull Plug

8" 3 Piece Ell
8" 45° Ell
8" Rt. Angle Ell
8" Lateral
8" Round End
8" Tee
8" Y
8" Split Bull Plug

10" 3 Piece Ell
10" 45° Ell
10" Rt. Angle Ell
10" Lateral
10" Round End
10" Tee
10" Y
10" Split Bull Plug

12" 3 Piece Ell
12" 45° Ell
12" Rt. Angle Ell
12" Lateral
12" Round End
12" Tee
12" Y
12" Split Bull Plug

4x3 Tee
6x3 Tee
6x4 Tee
8x6 Lateral
8x3 Tee
8x4 Tee

12x3 Swedge Nipples
12x4 Swedge Nipples
12x6 Swedge Nipples
12x8 Swedge Nipples
12x10 Swedge Nipples
10x3 Swedge Nipples
10x4 Swedge Nipples
10x6 Swedge Nipples
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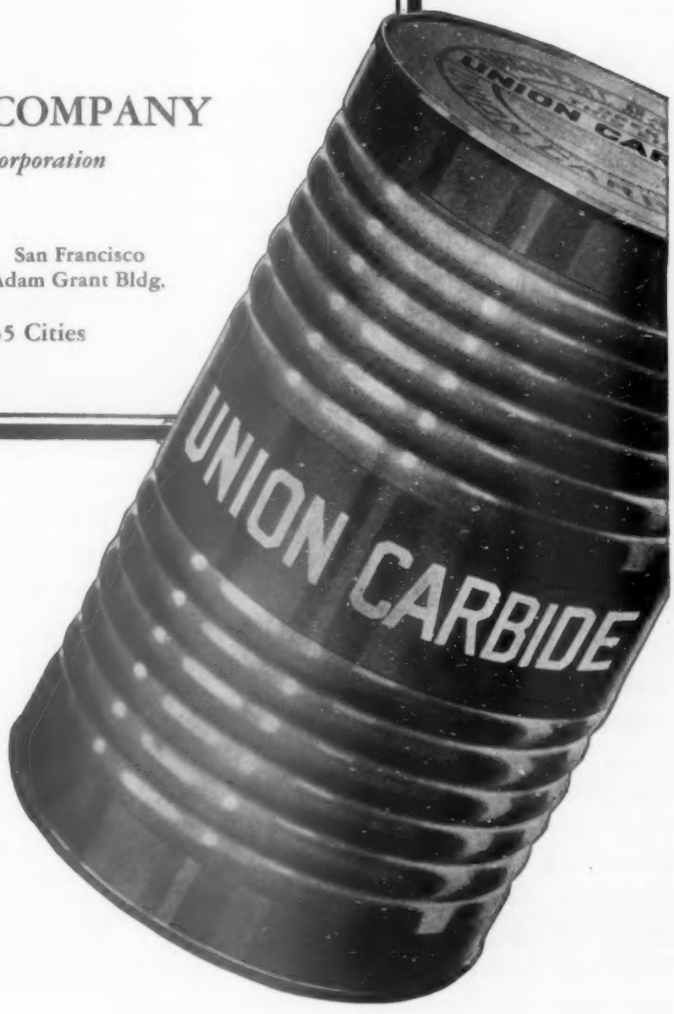

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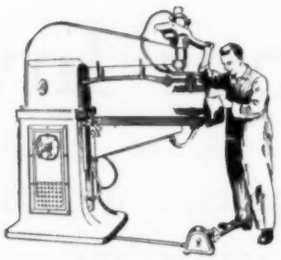

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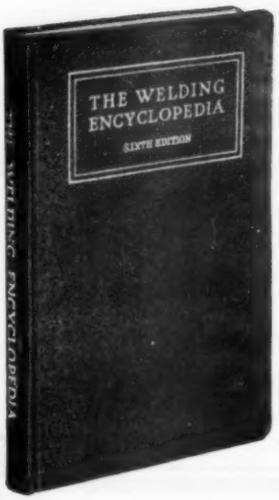

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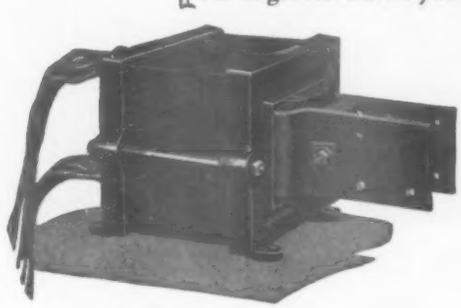

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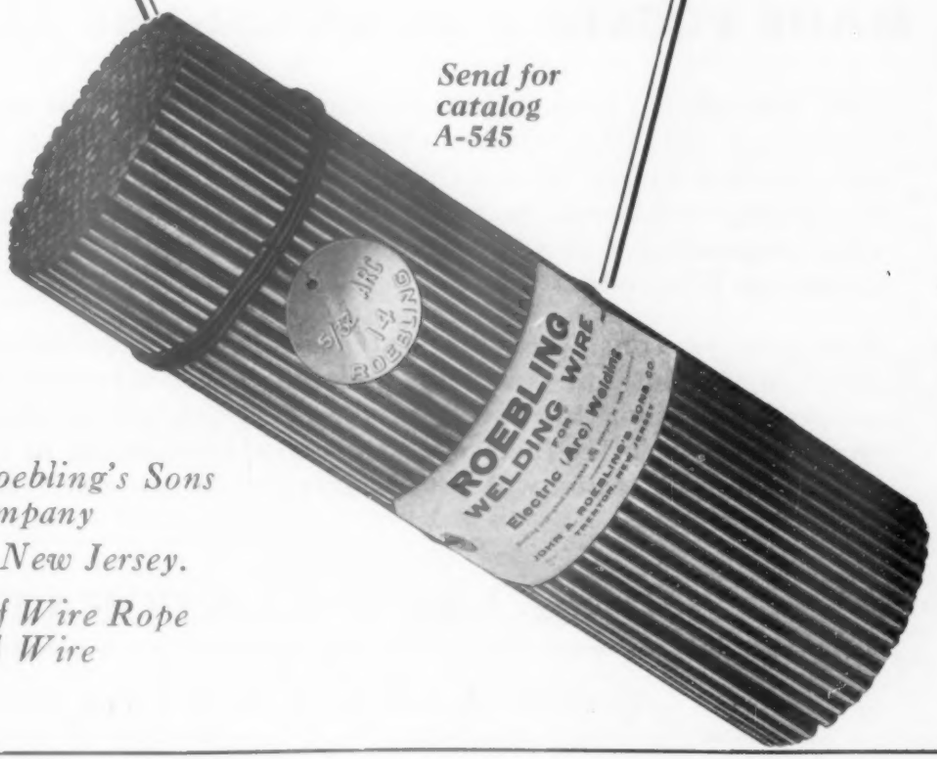

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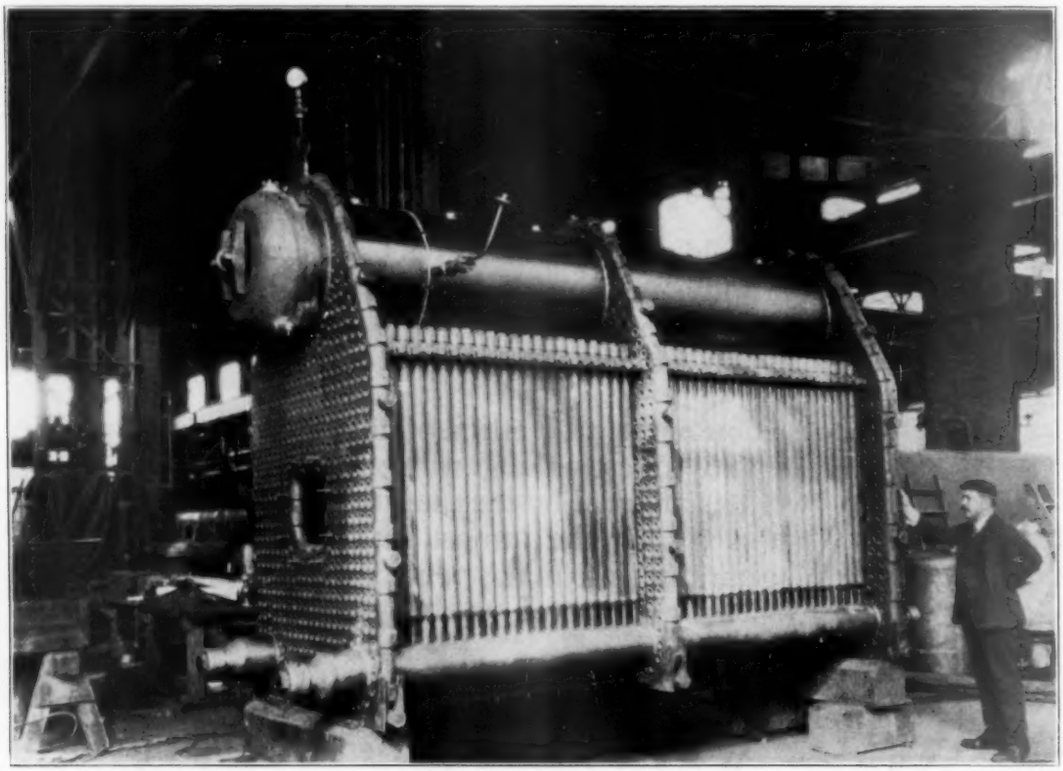

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EDITORIAL

Stability and Prosperity

IT is characteristic of the things expected from the new administration at Washington that it has gotten into action without the country showing any indication whatever of commercial upheaval. The trend toward continued prosperity continues, and continues to present an aspect of unquestioned stability. The nation seems to be getting away from the old sequences of inflation followed by deflation; of spectacular booms followed by periods of depression. This development in our national progress is not an accident but rather the result of combined efforts of trade associations, institutes, government departments and other groups, representing nearly every type of business and industry. Back of this great period of concentration upon more stabilized business conditions has been the helpful influence of the Department of Commerce under the direction of Mr. Herbert Hoover as Secretary. In the past our President has taken account of two fundamental economic principles: first, that the compilation of accurate statistical data is essential to the progress of every business industry; and, second, that business success is of importance only insofar as it affects the common good. In connection with the first principle, he transformed the Department of Commerce during his seven years of service, from a rather expensive luxury into a very vital and effective public service. In connection with the second principle, he has made business and industry realize that he has no interest in it as such but merely in relation to our progressive development as a nation. Executives know that they can expect no favors from him except as such favors fit into this broad picture. Consequently they also know that their competitors will be judged on the same basis. It is this undercurrent of absolute fairness plus an effectual organization that has made the Department of Commerce a body of great utility to theAmerican people. Current expressions of confidence in the present administration have a sound basis in the intelligent and constructive activities of our President during the period which preceded his nomination for the office of President.

In Terms of Rolling Stock

FUSION welding is still far from having covered its full field of usefulness in the reclamation of broken and worn metal parts. In spite of the growing possibilities for production welding, and the really startling developments in that direction during recent years, men responsible for the maintenance of plant equipment should not conclude with too little investigation that they are making all possible savings by reclamation welding. One plant engineer remarked recently that he had "dug up" a few days' work for his welder which saved the company several thousand dollars, work which had not occured to anbody else at the plant. One reason for this was that so few men in the plant were acquainted with all the applications of welding to repair work. Another important consideration often overlooked is the dollars saved which are not concerned with the actual value of the parts repaired. A railroad official was mindful of this point when he remarked that if it were not for welding it would be necessary to keep more than two hundred additional locomotives in service at a single terminal. Compare the cost of a few welding torches to the cost of that many engines and you have a picture of what welding may mean to any industrial organization, when it is used intelligently. There are many in the welding industry who take it for granted that the railroads are using welding to the limit, yet it is doubtful whether a third of the welding operations in daily use on railroads are standard practice. The oil industry spends millions annually to save more millions by hard facing, and other industries have only scratched the surface in developing this use for welding. It makes little lifference from what angle or through what industry the subject is approached, the answer is always the same—industry can profit much by learning more about the use of welding as a reclamation process.

The Present Status of Commercial Flying

AN ENTIRELY new field for the engineer is being opened up by the growth of commercial aviation, says the American Air Transport Association, which gives some interesting figures on the present status of commercial flying. In 1928 commercial and military planes in the United States flew 58,000,000 miles divided into 18,000,000 miles military flying and 40,000,000 miles for air mail, express, passenger and civil flying, such as scenic tours, aerial advertising, crop dusting and spraying, messenger service, private flying for both business and pleasure, student and pilot instruction, etc. The government is rapidly adding to the lighted airways and there are now 8,000 miles over which the mail and passenger planes shuttle back and forth between dusk and dawn, and there was a notable improvement in the weather forecast and the radio equipment installed to aid pilots in maintaining their courses under conditions of poor visibility. America's airway map received such substantial additions that the close of the year found commercial planes flying daily over 36 states with daily calls at 108 cities, which are centers for trading areas having 80,000,000 population. The mail planes alone flew 7,200,000 miles with 1700 tons of mail, 30,000 express packages and hundreds of passengers. Announcements have just been made that equipment is now being purchased for at least two transcontinental passenger lines and within the next six months many strategic cities of the United States will be linked up with tri-motored 12 to 34 passenger plane service. A most important step was the agreement between air transport interests and railroad executives to inaugurate several air-rail passenger lines.

The Radio and the Welder

DOUBTLESS many welders obtain so much entertainment from the radio that they will not feel badly because this same medium has been the means of taking away from them some of the business they have had in the past. There was a time when every unexpected cold spell would be the cause of swamping the job welder with cracked cylinder blocks and radiator repair jobs. Service broadcasting programs of various kinds have reduced the volume of this business to considerable degree by reminding automobile owners of the weather forecast and warning them to either drain their radiators or put in anti-freeze solutions. In this way the welder loses out on what used to be considered a regular run of seasonal work. However the other programs are good and the welder can make up for this slight loss of business by looking around for customers for some of the more recent developments in the application of the welding process.

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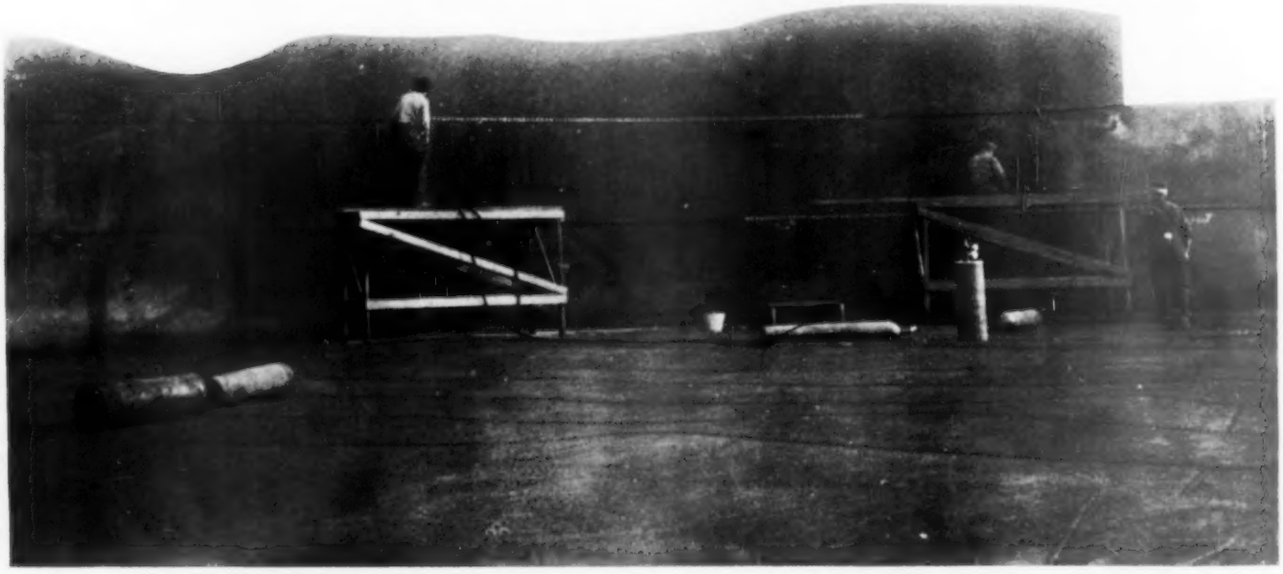

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Design of Welded Joints for Aircraft*

Economical Production is Greatly Facilitated by Use of Jigs for Standard Assemblies—Welded Joint Solves Problem of Reducing Weight of Tanks

By J. B. Johnson

Chief, Materials Unit, Wright Field, Dayton, Ohio

PART II

THE oxy-acetylene welding of aircraft parts does not require welders of extraordinary skill. A mechanic accustomed to welding heavy sections will have difficulty at first, but a careful selection of the correct welding tip and a short period of training on simple joints are sufficient. The quality of a welder's workmanship should be checked by tensile and ductility test specimens prepared at frequent intervals. The specimens may be in the form of plain butt or fillet welds and also longitudinal seam welds.

The assembling of small parts for individual fittings and of the larger components of the structure is done in jigs, such as shown in Figs. 11 and 12. The various pieces are cut to size. The ends of the tubes and sheet metal are machined square and filed free from burrs and feather edges. The surfaces are cleaned of paint, scale and other foreign matter. The pieces are clamped in jigs and tack-welded. The sequence in which several seams are welded is important, and changing the order may eliminate cracking and distortion. A small torch which can be used in corners is most useful, and tips, drill sizes No. 71, 68 and 58, can be used for metal up to ⅛ in. thick. Tips with drill sizes No. 55, 53 and 51 are better suited for work on thicker sheets, tubes, machined parts, and forgings. As a welder becomes more skillful he can use a larger tip and work faster.

The welding time on an airplane will be from a minimum of 100 hr. on a small single seat plane to 2,000 or more hours on a large transport or cargo airplane.

Repairing a Welded Fuselage Structure

The low cost of maintenance caused by the use of welding cannot be over estimated and will be of increasing importance in the operation of commercial aircraft. A study of the relative costs of a general overhaul on wooden fuselages and welded steel fuselages show a difference of from 15 to 25 per cent in favor of the latter. An airplane structure, whether built of wood or metal, which is fastened together with rivets, bolts, or other mechanical devices, will sooner or later loosen up at the joints and a complete overhaul is necessary, generally involving the replacement of several parts. A welded structure is rigid and cannot develop play in the joints. If it is damaged by a crash it can be repaired at the damaged section and will have a strength equivalent to the original structure. The facilities for making repairs are available everywhere. Several methods of repair are shown in Fig. 13. The instructions issued for the repair of welded structures by the United States Army Air Corps contains the following precautions:

"No splices shall be made in structural members (longerons, spars, interplane struts, and landing struts) by butt welds subject to direct tension or bending stresses, unless the joint is reinforced by riveting, pinning, telescoping, or other auxiliary means.

"Welded joints shall not be cleaned up by filing, as such treatment causes a loss of joint efficiency. Welded joints shall not be filled with solder, brazing metal, or any other filler. The joining of parts by filling holes with fused welding wire in lieu of a rivet or bolt is not permitted.

"No welds shall be made over a failure in an electric weld. The cast structure of the electric weld shall first be removed by chipping off before welding with the oxygen-acetylene torch.

"The parts to be welded shall always be cleaned by sandpapering or by wire-brushing.

"In a telescope joint, the splice shall be made with a fish-

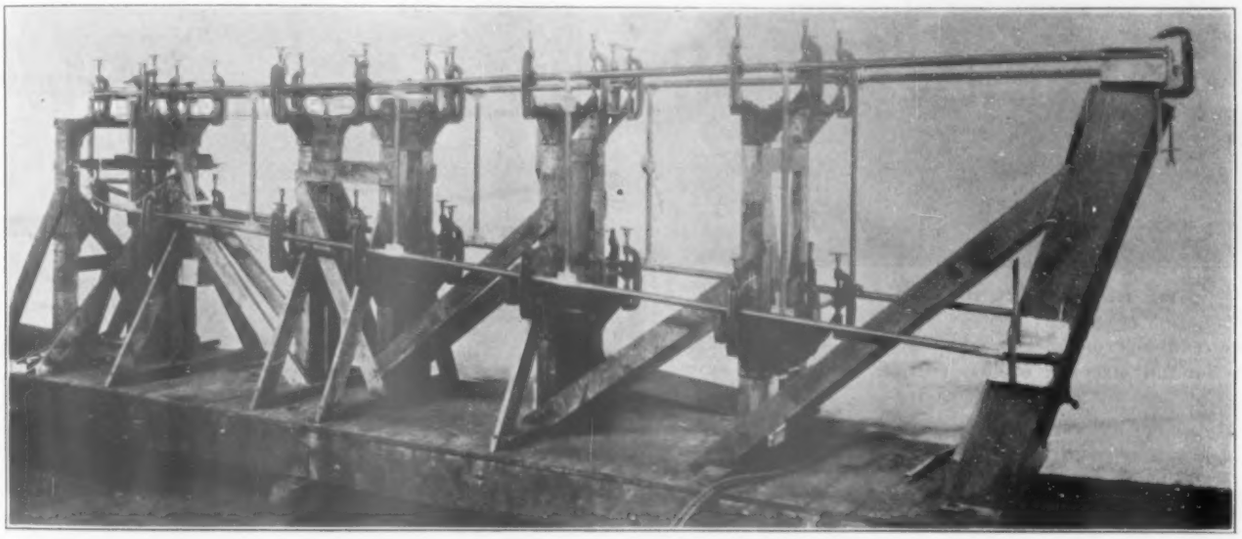


Fig. 11. Practical Design of Jig for Welding Fuselage Sections.

**This article was prepared by Mr. Johnson as a contribution to the Report of the Oxy-Acetylene Committee of the International Acetylene Association for 1928. An abstract of it was included in the printed report presented at the Annual Convention of the Association held at Chicago, November, 1928. Illustrations by courtesy of Airway Age.*

mouth form or diagonal cut so that the wall of the tube will not be heated at a certain cross-section as in the case of a butt weld. Where practical, the fish-mouth shape splice shall be used in preference to the diagonal shape splice, as it permits a better welded bond of the tubes. The length of the cut as measured on the outside wall of the tube shall be not less than one diameter of the tube and preferably two diameters of the tube. The ends of the prongs shall not be appreciably rounded or flattened.

"The splicing shall be done as close to the strut as possible,

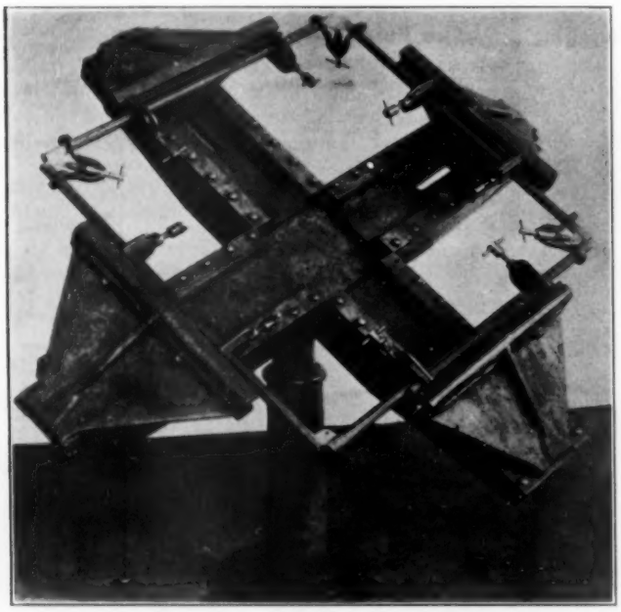


Fig. 12. Type of Jig for Small Assemblies.

since a tubular member is under greatest stress in the middle and the full strength in that portion of the tube should be retained.

"Misalinement of the tubular structure during welding, due to contraction and expansion of the metal, can be prevented by using wood braces with notches in the ends to hold the tubes in place. Care shall be exercised to maintain the true alinement of the strut structure when new tubes are used to replace the bent or damaged ones. This can be done by measuring the distance between strut points of corresponding members which are not distorted and by reference to the drawings when available."

The United States Army has developed a kit for emergency use, Fig. 14, which, together with a welder, can be carried in any two-place airplane and set up alongside an airplane in the field.

Welding Aluminum Tanks

The fuel tank, which is an essential accessory to the airplane, has been the subject of considerable experimentation and development. The tanks used ten years ago were generally made of tin plate, although in a few cases brass and copper had been tried. These tanks were satisfactory, in that they were durable and easy to repair. The weight, however, of a fuel tank made of these materials is a disadvantage. The logical method of reducing the weight was to change to a material with a lower specific gravity. Ninety-nine per cent aluminum sheet and the strong aluminum alloys come in this class. A comparison of the weight per gallon of gasoline capacity, as shown in Table IV, indicates that the welded aluminum tank is only a little more than 50 per cent of the weight of similar tanks made from the other commercial sheet metals. The strong aluminum alloys should be heat-treated after welding. Additional protection to resist corrosion is also necessary with a strong aluminum alloy tank.

Table IV

Weight in pounds per gallon of gasoline capacity as determined for various designs of tanks

Welded aluminium	.40-0.62
Terne plate	.72-0.86
Brass	.84-1.01
Monel metal	1.03
Stainless iron	1.00
Copper	0.86

The methods of fabrication used in connection with coated steel and brass could not be used readily with aluminum inasmuch as no satisfactory aluminum solder has been developed which has strength and corrosion resistance and at the same time will wet a surface and flow easily into a joint. There was some difficulty experienced by aircraft companies when welding with the oxy-acetylene torch was first applied because of the inexperience of the welders in handling aluminum, but

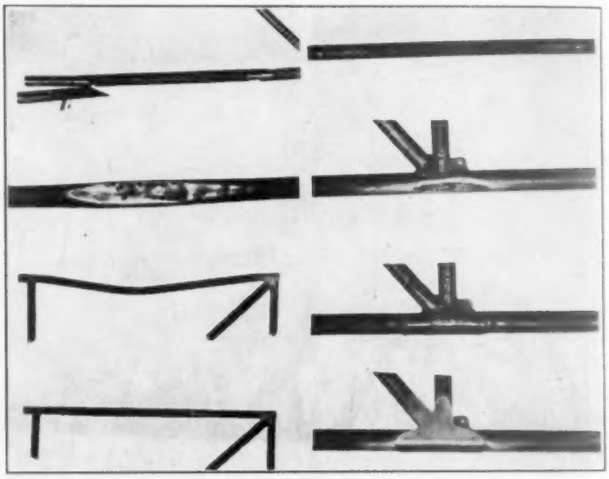


Fig. 13. Methods of Repairing Welded Tubular Structures.

this has been overcome to a large extent, and the majority of tanks, where weight saving is a primary consideration, are made of welded 99 per cent sheet aluminum. The fittings on these tanks, instead of being made of brass and bronze with a specific gravity greater than eight, are made of aluminum alloy castings with a specific gravity of less than three.

Welded tanks range in capacity from 25 to 150 gal., although these by no means represent the limits, for welded tanks with greater capacities have been constructed. The large, flat plate area of these tanks makes it desirable to use a slightly heavier gage than would be used for brass or coated steel. Tanks of 0.032 and 0.40 gage have been found to require more maintenance in sizes of approximately 110 gal, than tanks of 0.051-gage material.

Cylindrical tanks of heavier gage (0.081), without baffles, have also been used successfully. Care must be taken that a corrugation, rosette, or some other means of compensating for the expansion and contraction of the aluminum during welding is incorporated in the design. The tanks shown in Fig. 15 illustrate methods which have been successfully employed.

Welding Auxiliary Tank Connections

The problem of fastening the auxiliary connections, such as filler-neck, flanges for gage connections, dump valves, etc., has received special attention. Fig. 16 illustrates a tank with which difficulty was experienced on account of the filler-neck breaking away at the weld because of vibration. An examination of the joint indicated that cracks had been caused by

unequal heating and cooling during the welding process. Attempts to reweld to stop the leaks were not successful, since there were no means adopted for taking care of the expansion and contraction of the sheet. The character of the cracks is shown in Fig. 17. It will be noted that the welding of the casting distorted the sheet. These failures can be remedied by a circular corrugation in the sheet around the joints of the filler-neck casting and the top of the tank and by separating the two castings a sufficient distance so that the welds will not interfere.

The material which has been used for these castings has been the standard foundry alloy containing 8 per cent copper

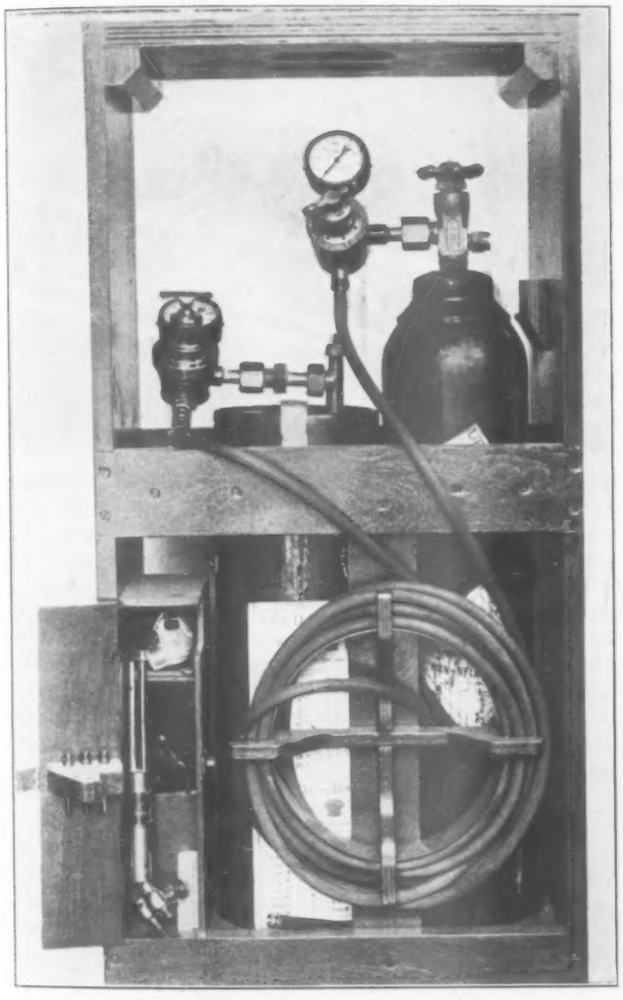


Fig. 14—Portable Welding Outfit for Emergency Field Repairs.

and known as S.A.E. No. 32. A more satisfactory alloy would be one which would have less shrinkage and would flow more easily under the torch, such as the 5 per cent silicon-95 per cent aluminum, or the 4 per cent copper-3 per cent silicon-93 per cent aluminum alloy.

The welding rod generally used for welding tanks has been the 95 per cent pure aluminum and 5 per cent silicon is better for this purpose, especially for joining the castings and the sheet metal. The same flux is used with either type of rod. The 5 per cent silicon, aluminum rod, produces a better weld than a commercially-pure aluminum rod, since, its initial melting point is about 1070 deg. Fahr., or approximately 150 deg. below that of pure aluminum sheet. The silicon also has the advantage of solidifying over a range of temperatures and has a low solidification shrinkage which allows it to absorb the temperature strains set up in welding. There is very little difference in the tensile strength of joints made with either type of rod, as tests made on pure aluminum strips welded with both types broke at about 13,000 lb. per sq. in. outside of the weld in the annealed aluminum strip.

The corrosion of the castings which form the accessories of the gas tank is also important, and in this particular the silicon-bearing alloys, especially the 5 per cent silicon, are much superior to the 8 per cent copper alloy. The machinability

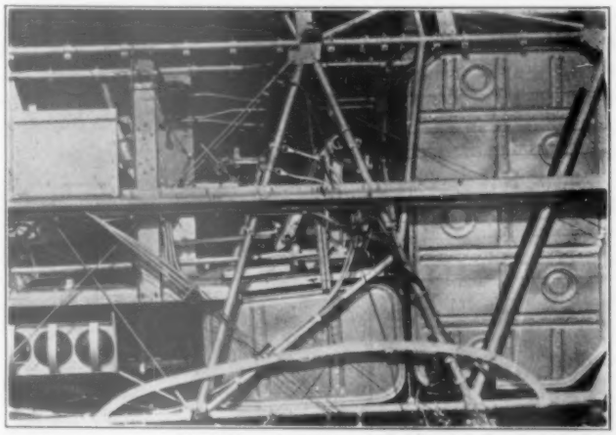


Fig. 15. Installation of Welded Aluminum Tanks.

of the former, however, is not so good and the alloy mentioned above containing 4 per cent copper, 3 per cent silicon, and 93 per cent aluminum is a good casting alloy which has good machinability and also welds satisfactorily.

United States Army Air Corps Instructions

The following instructions, which have been prepared by the United States Army Air Corps, govern the repair of aluminum welded tanks in the field:

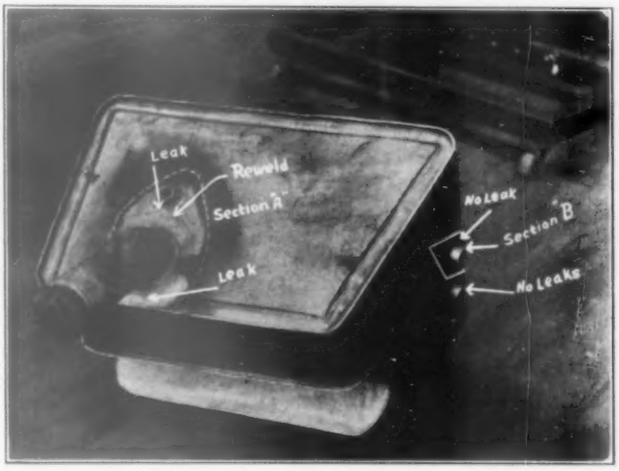


Fig. 16. Welded Aluminum Tank Showing a Failure in the Joint Between the Aluminum Castings and the Shell.

"**General**—The welding of aluminum does not present any particular difficulties if the welder realizes that the melting point of aluminum is much lower than that of steel and, therefore, requires less heat and more rapid manipulation. The melting is most successfully done with the oxy-acetylene torch.

"**Welding**—When it is desired to join the edges of sheets, the flange type of weld is used. The edges to be joined are bent up an amount equal to about three times the thickness of the sheet. A flux is applied to both sides and the edges are then held together by small clamps and tack-welded at intervals of about one inch by melting the metal together at these points, touching up if necessary with welding rod made from

a strip of the original sheet. The clamps are then removed and the weld is completed by melting down the flanges, holding the torch at an angle of 45 deg. with the work and in line with the weld and progressing at a uniform speed. Little or no metal is added from the welding rod. A round and smooth bead should be formed, well rounded on both the upper and lower surfaces.

"If there is considerable oxide or heavy film on the sheets, the edges should be cleaned prior to flanging by immersion for 10 to 30 seconds in a hot solution of 10 per cent caustic soda or 10 per cent tri-sodium phosphate. The edges should then be rinsed in a dilute 10 per cent nitric acid solution, followed by hot water in order to remove all traces of flux, as this flux has a tendency to corrode the sheet. The immersion should not be longer than necessary to clean the surfaces. If the aluminum sheet is fairly clean, a wire brush or steel wood can be used in place of the cleaner. It is not always necessary to use a welding flux if the surfaces are clean, but if trouble

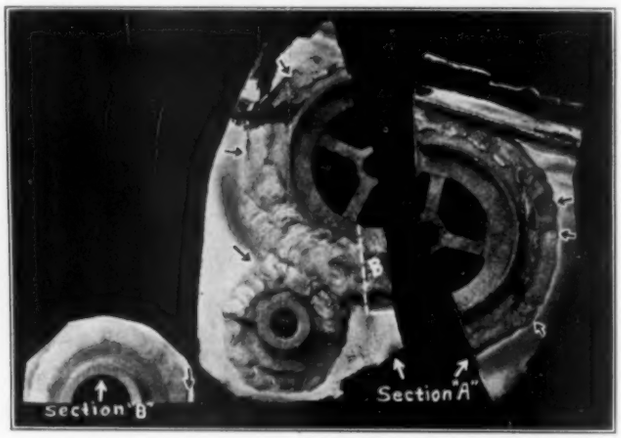


Fig. 17. Enlarged View of the Welded Seam Which Failed, Shown in Fig. 16.

is experienced, any good commercial flux may be used. The flux should be applied to the surfaces to be welded, and to the welding rod, with a brush. If the metal is slightly heated the flux will adhere and dry quickly.

"In joining fittings or sheet metal parts to the side of sheet, the usual fillet type of weld is required. After cleaning and applying the flux in the usual manner, the parts are tack-welded together at intervals by small applications of metal from the welding rod. The weld is then made by melting in a filler rod, fusing well with both sides of the joint. In this type of weld special care is necessary to avoid burning through the sheet.

"Welds are very liable to pull out unless provision is made for expansion of the metal during welding. This is generally done by depressions or corrugations in the sheet.

"Cleaning after welding—All traces of flux must be removed promptly after welding. Incomplete removal of the welding flux will cause corrosion. The flux can be removed by a scrubbing brush and hot water, followed by rinsing in running water or by treatment with a dilute solution of 10 per cent of either sulphuric or nitric acid, followed by rinsing in cold water."

The Welded Fuselage Has Proved Its Worth

There is a type of airplane structure in this country which might well be called standard. It has a welded steel tube fuselage, landing gear and tail skid. It has been developed in order to obtain maximum strength and rigidity with minimum weight and to use methods which are applicable to small or large production at relatively low cost for material, labor and overhead.

The safety factor in welded construction has been amply demonstrated. It has been used in the fastest racing planes and in the largest bombers and transports. Many an embryo pilot owes his escape from injury to the resilient, crashproof, military training airplane with its welded steel tube body and undercarriage. There are few well-informed aeronautical engineers and constructors at the present time who have not been convinced that welding is a safe and reliable method for joining steel. The airplane the next few years will be similar to the modern craft. Production costs will be decreased. The oxy-acetylene industry must assist the airplane manufacturer in this respect in order to maintain the present position of oxy-acetylene welding.

The elimination of wood in the wing structure will be ac-

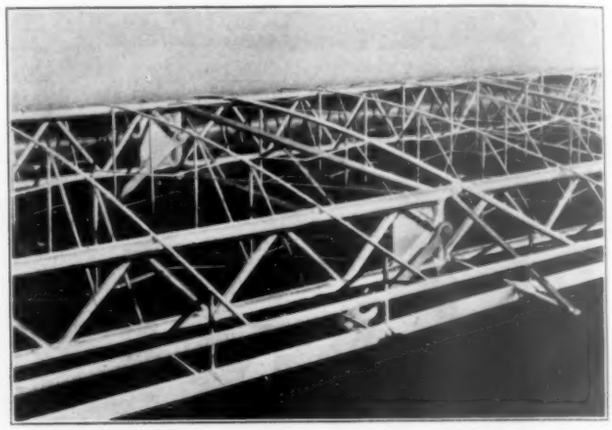


Fig. 18. Chrome-Molybdenum Beams and Aluminum Alloy Ribs.

complished for a number of designs within a comparatively short period. The structures will probably show a greater diversification in the selection of material and methods of manufacture than other parts of the airplane, but the application of welding has a promising future. The welded and heat-treated wing beam is one adaptation which gave a high load factor when tested in competition with wood and riveted aluminum alloy beams. The combination of steel-tube wing beams and drift bracing all aluminum alloy ribs, as shown in Fig. 18, illustrates the advantages to be gained in the use of the two metals in one structure. The multi-spar, welded monoplane wing is an interesting development of a structure in which all of the component parts are tubes and all the joints are made by oxy-acetylene welding. The advantages are torsonial rigidity and minimum deflection of the large, internally-braced cantilevers. These examples are additional of the acceptance by engineers of the wide applicability of torch welding to structures which are designed with high unit working stresses.

CLEVELAND WELDING SCHOOL VIEWS THIS "AGE OF SPEED".

On January 16th, the day and night classes of the Cleveland Welding School, together with wives and sweethearts, gathered at the auditorium of the school and saw a motion picture presented by the Industrial Film Service Company entitled "The Age of Speed."

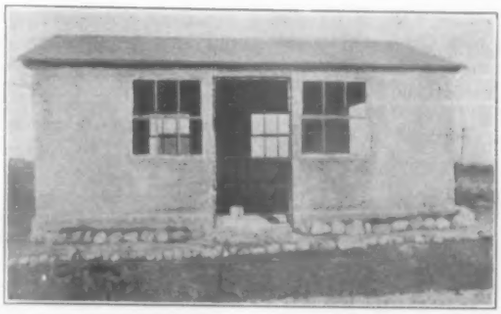
This picture shows the Twentieth Century Limited at 60 miles an hour; motor cars racing at 108 mi. an hour; motor boats skimming on the water at 82 mi. an hour; and airplanes doing 246 mi. an hour. The picture, incidentally, showed how oldtime mariners propelled their boats by galley slaves, and then showed, by way of comparison, the great Leviathan docking.

The "Age of Speed" is available for all schools and engineering and civic groups. There is no charge for the showing of these films.

Garage Has Welded Framework

Welder Uses Scrap Pipe to Good Advantage in Construction of Two-Car Garage Which He Guarantees to be Hurricane Proof

IT is unusual to pass a scrap yard of any size without noticing in it great piles of assorted sizes of pipe, some of which may come into use again as piping, but most of it destined to be remelted. Considering the great strength of this material in a structural sense, it is unfortunate that more welders do not take advantage of the ease of fabricating all sizes of pipe into useful articles.



Side View of Completed Garage.

There is no better or more economical way of building permanent railings, partitions, and other similar types of framework than by welding discarded pipe into the desired shapes. An account was recently published of a large dairy building, constructed almost entirely, including stalls, in this manner. Another interesting job was done by a florist, who found welding so useful in his greenhouses that he adopted it for the entire construction of a new greenhouse covering a full acre of ground, and containing an endless variety of applications of welded piping for brackets, benches, supports, etc.

Just recently a welder in a Chicago suburb has finished building for himself a two-car garage with an all-welded frame of steel pipe, which illustrates the ease of assembly of this type of construction. The illustrations tell a good deal about the details and show clearly the simplicity of the joints which can be used. The joints are not complete as would be required when joining pipe for carrying water, steam, oil or gas, because even the small amount of welding used here is two or three times stronger than a half-inch bolt would be in the same place.

The garage illustrated is twenty feet square. The frame sill is 1½-inch pipe, also the ridge-pole. The corner posts are 2-inch pipe and the three center posts are 4-inch pipe. The rafters are all 1-inch pipe, spaced on 12-inch centers. 1½-inch pipe is also used for the diagonal braces. The corner posts and center posts are set in concrete posts in the ground, and hollow concrete blocks are used around the bottom for the foundation.

A metal mesh was laid over and welded to the rafters, and to this was applied cinder cement and then a finishing cement. The side and end walls were likewise covered with the mesh and finished with cement. Metal window and door frames

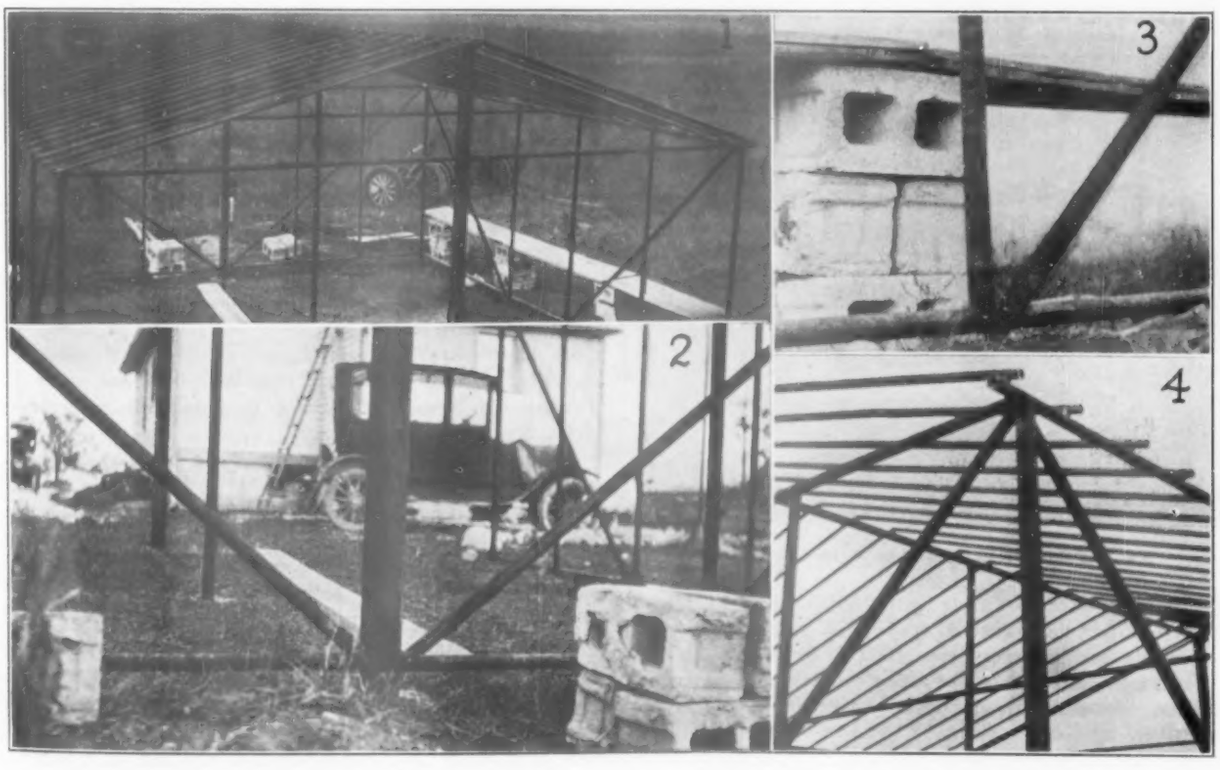


Fig. 1. Front View of Framework. Fig. 2. How End Post Is Joined to Sill and Braces. Fig. 3. Side Brace Joined to Sill. Fig. 4. Detail of Corner of Roof.

were used throughout. The result is a garage which is perfectly fireproof, an important factor because it adjoins a wooden frame building, and a fire inside the garage could not possibly endanger the dwelling. It is also well anchored, heavy, and rigid, and this is very advantageous in a flat country subject to violent wind storms.

Cost figures were not kept on this little building operation, because practically all the work was done in spare time at odd moments, and no attempt was made to save by skimping on materials. The welder was able to make big savings on the cost of the framework on account of his skill with the torch and his judgment of the strength of each connection, and consequently went to considerable pains to get the best obtainable on the remainder of the construction.

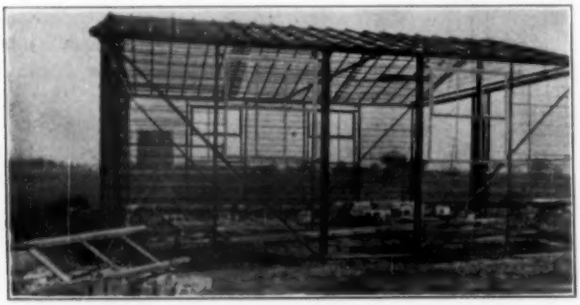


Fig. 5. Side View of Frame.

By using the same type of framework, and side walls and roofing of sheet steel, and being less thorough in the construction of the foundation, it would be possible to construct a garage or other small building on this same principle at very low cost. The interesting feature from the welder's point of view is, of course, the framework. This kind of frame construction is light, strong, and economical. Added strength can be secured at trifling cost by fitting a few of the joints a little more carefully, and making complete welds at the important points. In fact, the detail photographs shown here indicate that where strength is essential

Fig. 6. Wire Mesh Applied to Welded Frame.

good solid joints have been made on this building. To the layman it would seem that the uncovered frame is all ready to fall apart, and he would ask for every connection to be heavily built up as big as a conventional cast pipe-fitting. A welder, however, will readily note the real strength of the whole job and guarantee it to stand up against a cyclone.

FOUR-DAY SCHOOL FOR PRACTICAL WELDERS

During the week of the Automobile Show which was held last month in Minneapolis, the Williams Hardware Company and the Smith Welding Equipment Corporation of that city put on a very interesting program of welding instruction. Welders working on all classes of work and with all degrees of skill and experience were invited from the Minneapolis district, came to the city at their own expense and showed great interest in the work of the Four-Day School. The average attendance was approximately 125 with a maximum of 160 present on the second day. Many of these were skillful welders, some were blacksmiths with no skill at all and others had very little experience. During each of the demonstrations, the work was conducted at four points in the room so that the men could turn about and see the work being accomplished, to the best advantage. The demonstration work was actual welding on castings and other broken parts which had been prepared especially for this event. Among the speakers were Mr. B. P. Eddey of the Williams Hardward Company,

125 Welders Attended the Course Offered in Connection With Minneapolis Auto Show.

Mr. V. L. Sage of the Commercial Gas Company, Mr. P. H. Gagnon of the Dunwoodie Institute, Mr. Paul Smith of the Dunwoodie Institute, Mr. M. R. Bass, Dunwoodie Institute, and Mr. Stuart Plumley of the Smith Welding Equipment Corporation. The program occupied the time from 9:30 in the morning until 4:00 in the afternoon, February 5-6-7-8. It included motion pictures, demonstrations of welding and lectures on special subjects such as bronze welding, pipe welding, welding apparatus and supplies, liquid air and cutting. All of the demonstrations were carefully explained by the lectures and talks. Plans are now under way for an even larger school to be held during the Auto Show in Minneapolis next year.

THE ENGINEERING INDEX SERVICE INDEXES THIS JOURNAL

This journal is fully indexed—every issue, as soon as published—in a set of cards, which thus brings ready to your hand any article on any subject in this journal or in any one of 1700 other journals in all languages. This Engineering Index Service, instituted in January, 1928, is to be found in the Public Libraries of Newark, Cleveland, Bridgeport, Baltimore and the John Crerar Library, Chicago.

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WELDRITE ESTABLISHES NEW SHOP IN WALKERVILLE, ONTARIO

Weldrite Sales and Service have opened a new shop at 177 Walker Road, Walkerville, Ontario, just across the river from Detroit. This shop will be very completely equipped to handle not only repair jobs but production welding on a large scale. The equipment will include electric arc welders, electric resistance welders, and oxy-acetylene welding apparatus, as well as extensive machine shop facilities, so that a wide variety of production jobs can be handled completely within this one shop.

Proving the Merits of Structural Welding

Typical Structural Joints Are Welded and Tested to Fracture Before Gathering of Architects, Engineers and Contractors at University of Detroit

EVERY phase of the subject of Structural Welding was covered at the meeting of the Detroit Section of the American Welding Society held at the University of Detroit on February 16th. The meeting began at 11:30 a.m. with a demonstration, in the Engineering Laboratory, of welding structural member with the D.C. and the A.C. arc, as well as electric resistance butt welding of small members.

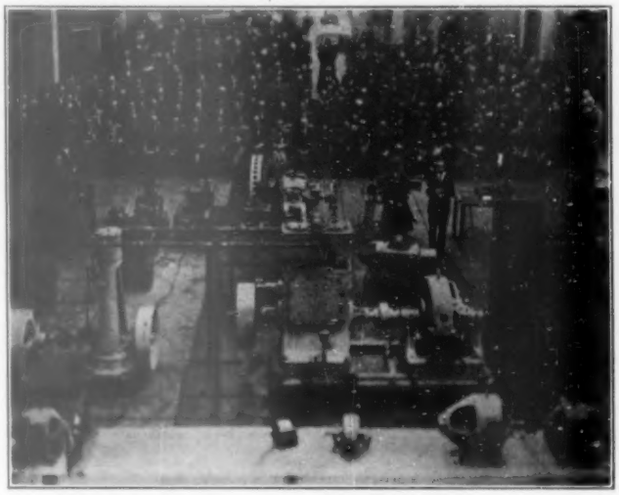
Mr. R. G. Richards, President of the Detroit Section, opened the session with an account of the work being carried on by the Structural Welding Committee, which was formed four years ago to cooperate with the Department of Building and Safety Engineering of the City of Detroit in the investigaton of the use of welding in structural steel fabrication. Mr. Richards is chairman of this committee, which is composed of engineers from the larger fabricators, architects, and welding shops. As a result of the cooperation between the committee and the local building departments, Detroit and vicinity are far ahead of other communities in the structural welding fields. Exclusive of the work done by the fabricating shops, between a quarter and a half million dollars worth of structural welding was done during 1928 by local welding contractors. It was under the auspices of the Structural Welding Committee that this meeting and demonstration were held.

Mr. R. E. Lawrence, Dean of Engineering of the University of Detroit, spoke on the part that welding is playing in the progress of structural steel fabricating, and Mr. A. M. Candy, of the Westinghouse Electric and Manufacturing Co., directed a demonstration of arc welding on structural members, using a number of different makes of arc welders, both D.C. and A.C., and explaining the principal requirements of good arc welding practice, both as to welding technique and design of the joint.

Followng this demonstration, the meeting was continued in the lecture hall, presided over by Mr. H. A. Woolfter of the Swift Electric Welder Co. Mr. Candy discussed further the characteristics of the welding arc, illustrating the points by means of an arc proector which threw the image of the arc and crater on a motion picture screen, affording an excellent opportunity to study the transfer of metal and the behavior of the arc under different conditions.

Mr. C. A. Daymude, Chief Engineer of the Department of Building and Safety Engineering of the City of Detroit, addressed the meeting on the requirements of the city in regard to structural welding, and explained the attitude of his department toward the substitution of welding for riveting. A conservative yet very open-minded attitude has characterized the work of the Department in this direction, and more and more welding is being specified by the architects and passed by the City. With the cooperation of the Structural Welding Committee, the building authorities have drawn up a code of specifications governing the use of welding in building construction. Detailed plans of all welding work must be submitted and approved before any actual operations are begun. These plans must include specifications, details of connnections and loads thereon, and a schedule showing amount of welding, size of fillet beads, length of fillet beads and spacing edge to edge of beads. Provision is also made for proper inspection and tests, and emphasis is laid upon the careful selection of operators and the responsibility of welding contractors. Allowable working stresses per linear inch of different size fillet beads, and for button or plug welds, are also included in the instructions.

The success of structural welding in Detroit under this code has been excellent testimony to the feasibility and practicality of the process in this field under proper supervision and regulation. Its rapidly increasing use in Detroit and vicinity is evidence that



Section of the Engineering Laboratory of the University of Detroit, Where Architects, Engineers and Contractors Witnessed Demonstration of Structural Welding.

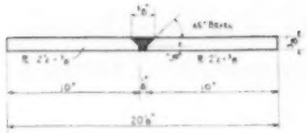
architects and fabricators are awakening to the distinct advantages offered by welding.

Large-scale applications of structural welding in other sections of the country were described by Mr. Candy, showing a number of slides illustrating shop buildings, bridges, and other structures entirely welded, and also by Mr. H. M. Priest, of the American Bridge Company, who described the construction of the eleven-story addition to the Homestead Hotel, Hot Springs, Va. Mr. J. C. Lincoln, of the Lincoln Electric Company, exhibited a motion picture showing the shop and field welding on the Upper Carnegie store and office building in Cleveland. Each of these speakers enumerated the advantages of welded construction which were proved by the structural jobs described, and pointed out still further advantages which can be realized with continued development and more general acceptance of welding.

Following this program, the meeting adjourned to the testing laboratory, where a number of typical welded structural joints, which had been made up during the meeting, were tested for various kinds of loads, some of the welds being in tension, some in shear, and some in tension and shear. Both fillet and button welds were included in the tests, the results of which are recorded in the accompanying table.

These tests, together with the facts and evidence brought out during the meeting, presented the case for structural welding most convincingly, and gave the architects and fabricators present greater confidence in the welded joint, and ample reason for studying the application of welding to the erection of their steel structures.

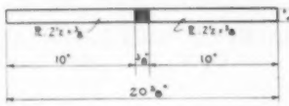
(1)



STRAIGHT TENSION — ⅜" BUTT WELD WITH BEVEL

PLATE AREA	0.94 □"
WELD AREA	0.94 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	38000#
CLASS OF FAILURE EXPECTED:	FRACTURE OF WELD IN TENSION

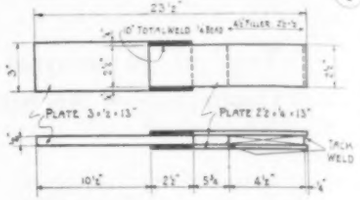
(2)



STRAIGHT TENSION — ⅜" BUTT WELD WITHOUT BEVEL

PLATE AREA	0.94 □"
WELD AREA	0.94 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	38000#
CLASS OF FAILURE EXPECTED:	FRACTURE OF WELD IN TENSION

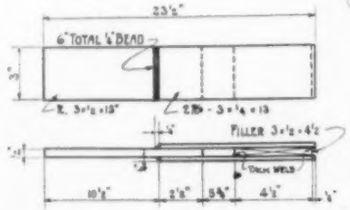
(3)



STRAIGHT SHEAR — ¼" BEAD

MINIMUM PLATE AREA	1.25 □"
MINIMUM WELD AREA	1.77 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	53000#
CLASS OF FAILURE EXPECTED:	FRACTURE OF ALL WELDS IN SHEAR

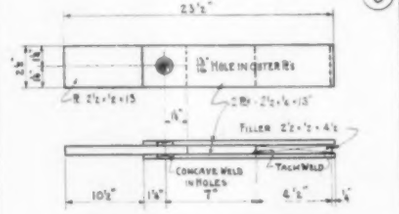
(4)



SHEAR COMBINED WITH TENSION — ¼" BEAD

PLATE AREA	1.8 □"
MINIMUM WELD AREA	1.06 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	32000#
CLASS OF FAILURE EXPECTED	FRACTURE OF BOTH WELDS UNDER COMBINED SHEAR & TENSION

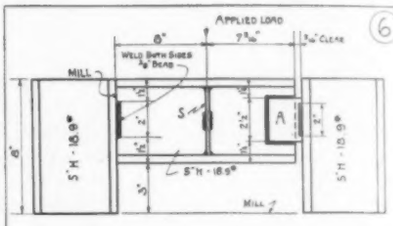
(5)



STRAIGHT SHEAR — WELDED UP HOLES

PLATE AREA	1.25 □"
WELD AREA BOTTOM OF HOLES	1.04 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	31000#
CLASS OF FAILURE EXPECTED:	SHEAR OF WELD OF BOTH HOLES

(6)

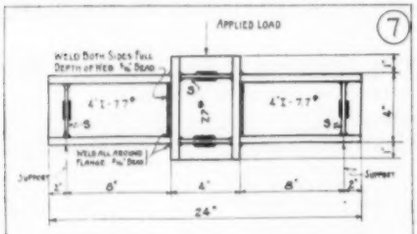


STRAIGHT SHEAR — BEAM & COL. CONN. ¾" BEAD

A = 2 ∠s. 2×3½×2½ , S = 2 STIFFENERS 1/4×3/4, TACK WELD AS SHOWN

WELD AREA (1 END)	0.53 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	32000#
CLASS OF FAILURE EXPETED	SHEAR OF WELD AT CONNECTION TO COL. FACE

(7)

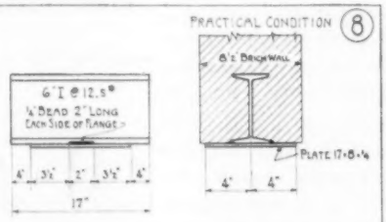


BENDING TEST — BEAM & COL. CONNECTION

S = 6 STIFFENERS 1¼×⅜ TACK WELD AS SHOWN

WELD AREA □ (AT ONE FLANGE)	0.68 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	23000#
CLASS OF FAILURE EXPECTED:	BOTTOM FLANGE OF BEAM PULLING AWAY FROM COL.

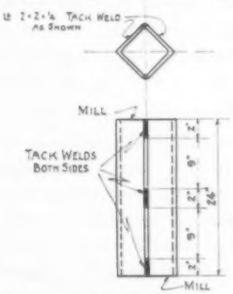
(8)



SHEAR & TENSION — WALL PLATE CONNECTION TO BEAM LINTEL

WELD AREA □	0.71 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	21000#
CLASS OF FAILURE EXPECTED:	DISTORTION OF RATE BEFORE WELD FAILURE

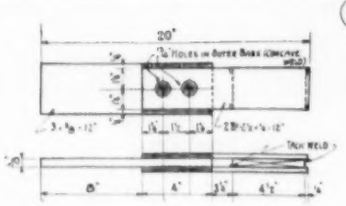
(9)



COLUMN SECTION

TEST ON TENACITY OF TACKS UP TO CRIPPLING OF COLUMN (80000# ±)

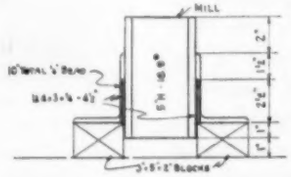
(10)



STRAIGHT SHEAR — ¼" BEADS & WELDED UP HOLES

MINIMUM RATE AREA	1.125 □"
WELD AREA ⊥ TO □	4.8 □"
ESTIMATED APPLIED LOAD AT TIME OF FAILURE	62000#
CLASS OF FAILURE EXPECTED:	IN 3×⅜ R BY TENSION

(11)



STRAIGHT SHEAR — SEAT ANGLE & COL. CONN. ¼" BEAD

WELD AREA □	1.71 □"
ESTIMATED APPLIED LOAD AT TIME OF WELD FAILURE	53000#
CLASS OF FAILURE EXPECTED:	SHEAR OF WELDS

Specimens of Simple Welds for Tests in Tension and in Shear, as Well as Typical Structural Joints, Were Made Up and Tested to Failure During the Meeting. The Results of These Tests Are Shown on the Opposite Page. Note That in Most of the Tests the Specimens Developed a Strength Greater Than the Estimated Theoretical Strength.

The meeting and demonstration were declared a success by those who attended, which included about 350 supervisors of welding, architects, structural engineers, contract welders, and representatives of welding equipment manufacturers: General Electric Co., Westinghouse Electric and Manufacturing Co., Lincoln Electric Co., Swift Electric Welder Co., Electric Welding Machine Co., Seneca Welder Corp., Central Steel and Wire Co., Page Steel and Wire Co., Koro Corporation, Air Reduction Sales Co., J. A. Roebling's Sons Co., Purox Company.

Copies of the program of the meeting, including sketches of the test specimens, may be obtained from Mr. R. G. Richards, Barnes Wire Fence Co., 10371 Northlawn Ave., Detroit, Michigan.

The functioning of the structural Welding Committee has been remarkably efficient and constructive. With whole-hearted cooperation between architects, contract welders, manufacturers of welding equipment, and the city building officials, answers have been forthcoming for every question and a solution for every welding problem as they arose, with substantial progress as the result. Mr. Richards and his committee are deserving of much credit for their vision and their pioneering efforts in this field.

Structural Specimens Before and After Tests to Failure.

Test Data on Demonstration of Structural Welding

Detroit Chapter—American Welding Society—Engineering Building—University of Detroit—February 16, 1929

Test No.	*Weld Loading*	*Bead Size*	*Estimated Load to Fracture*	*Ultimate Applied Load*	*Strength of Weld*	*Amperage Used*	*Type of Machine*	*Grade of Welding Wire*	*Remarks*
1.	Tension	⅜" Butt	38,000	45,370	18150#/Linear Inch 48200#/Square Inch	160	General Electric	Roebling ⅝ Bare	Broke in weld.
2.	Tension	⅜" Butt	38,000	35,570	14200#/Linear Inch 37800#/Square Inch	160	Westinghouse	Page-Armco ⅛ Bare	Broke at junction of weld and parent metal.
3.	Shear	¼" Fillet	53,000	76,490	7649#/Linear Inch	160	General Electric	G. E. Type "F" ⅝ Bare	Broke in plate, then by shear in weld.
4.	Shear and Tension	¼" Fillet	32,000	55,475	9250#/Linear Inch	150	Westinghouse	Page-Armco ⅛ Bare	Broke in weld on one side of plate.
5.	Shear	1⅛" Welded up hole	31,000	31,480	15740#/Per Hole 30300#/Square Inch	105	Seneca	Roebling ⅝ Coated	Sheared in weld.
6.	Shear	⅜" Fillet	32,000	87,430	10900#/Linear Inch	180	General Electric	G. E. Type "F" ⅝ Bare	Sheared in weld at end "B." Min. weld area in 6 should read 1.060.
7.	Shear and Tension	5/16" Fillet	23,000	41,990	8200#/Linear Inch	150	Lincoln	Lincoln ⅝ Bare	Broke in weld in Tension Flange.
8.	Shear and Tension	¼" Fillet	21,000	14,840	3820#/Linear Inch	105	Seneca	Page-Armco ⅝ Coated	Broke in weld.
9.	Compression Test on Tack Welded Column		80,000	71,350	.....	95	Seneca	Roebling ⅝ Bare	Column bent, tacks held.
10.	Tension	1⅛" Welded holes ¼" Fillet	62,000	59,950	.....	150	Westinghouse	Page-Armco ⅛ Bare	Broke in plate, 53300 square inch (plate).
11.	Shear	¼" Fillet	53,000	94,010	9401#/Linear Inch	160	Westinghouse	Roebling ⅝ Bare	Tearing of weld due to bending of angles.

THE CONSTRUCTION OF TRUCK TIRES

(Excerpt from address by F. W. Stavely of Firestone Tire & Rubber Co. given before Society Automotive Engineers, Northwest Division, Portland, Ore.)

"There are approximately 390 kinds and types of axles in service. This considerably complicates wheel changes. If wheels cannot be obtained, the only alternative is to cut down the steel wheels. The practice employed is to machine the spokes to the proper length, shrinking on a cast steel felloe band and welding in place. If the spokes are cut with a torch they should be left somewhat longer than necessary and then machined to the proper length. This insures a stronger weld.

"The question of proper tire clearance is just as important in this case as was previously pointed out for change over from high pressure to balloon equipment. Wherever possible it is advisable to use 24" tires as this will often avoid trouble that might arise due to brake drum clearance. The minimum clearance of the tire with the nearest point of interference should be one inch. The tire should not extend beyond the fender nor should they rub against the fenders with full deflection of the springs. Special attention should be given to the amount of offset necessary for the felloe in order to provide proper body and brake drum clearance, etc. When welding the felloe band on the cut down steel wheel it should be offset to the outside of the center line through the spokes, in order to give sufficient body clearance. Therefore the center line of the felloe is not in line with the center line of the spokes."

PROFITLESS WELDING DOES NOT PAY

By J. D. Tierney*

THE objective of most welding job shop owners in going into the business of welding is primarily to make a profit. The hours which are spent in this work and materials which are used in conjunction with the labor are the things which have to be purchased at a certain price and resold at a higher price, an ample figure to allow for a legitimate and justifiable profit.

The progress and success of the welder's individual business will depend largely on whether the thing he has for sale, his services, are made up of cheap materials and inferior workmanship or whether he purchases quality in both materials and workmanship and in turn furnishes either "price-issue-only" service, or "quality" service to his trade, his customers.

The Customer Is the Life of the Industry

When all is said and done, the buyer of welding service is the life of the welding industry. The very heart and soul of progress in welding depends on how much welding service will be purchased by those customers who can use it and it is a deplorable spectacle to watch the retrogression of welding job shops and welding businesses, in which the promoters of these failing businesses have succumbed to buying cheap materials and inferior labor and then resort to the "hurried-up-slip-shod" practice of producing the customers' wants and needs as cheaply as possible; with the result that the work in due time fails, and proves unsatisfactory to the buyer,—eventhough he be a "price-only" buyer.

Competitive Bidding Is Tough on Profits

Step into any of the larger cities and industrial centers of the country, make a tour of the welding job shops with a specific welding problem which gives promise of a few thousand dollars worth of work. Make your inquiry a very binding one, with little or no room for misinterpretation as to the specifications you require in your welding problem. See to it that the welding job shop owner thoroughly understands what is required of him to complete the work and make it specifically clear that the work will have to be guaranteed to your entire satisfaction. THEN TELL HIM THAT NINE OR TEN OTHER LOCAL WELDERS ARE BIDDING ON THE SAME SPECIFICATIONS. Do this very thing with ten job shops which are in the one city or in close proximity with each other, then go back to your office and wait developments.

Such a test will reveal why so many job shops fail over a period of time. It will tell a story which is very important to the job shop welder who desires to progress and succeed and he can learn why many shops are now losing ground and why some few shops are succeeding.

Quality Not Sold at Bargain Rates

There is no profit in buying quality materials and hiring skilled workmen and selling these quality issues at "cut-throat-rates," any more than there is profit in buying inferior materials, hiring unskilled workmanship and pawning them off on a "hurried-up" basis to users of welding service, even if the users might be the greatest cranks in the land on the subject of "price-only."

Most job shop welders who are going along successfully with their business will tell you that their sales trouble is not the kind of educational work which is known as "missionary work" where the prospective buyer learns something new which shows him how welding can help him cut costs and increase profits. They will tell you that most of their advertising-selling efforts have to be designed to do "revival work" where they have to build new confidence in the mind of the prospective buyer, the kind of confidence which will eventually, if he is treated right, teach him that welding can be done right, for a right price, low enough to allow him to increase his profits by using it.

Customers Must Be Satisfied

It is no secret that the successful job shop owners look to their customers' satisfaction and profit before they consider their own individual profit at all. Their customer, whether a prospective one or a repeat one, is their first consideration. The customer must first and always profit or the transaction is going to prove fatal to him and if his confidence in welding is dealt a death blow, the welder who kills his confidence not only robs himself of a customer, but also robs the industry as a whole, from hundreds up to thousands of dollars which might have gone into the industry through the disappointed customer's use of services, which could have been rendered in a manner profitable to the customer and the welding job shop owner.

Avoid the Profitless Jobs

Sooner or later the "price-cutting-practices" and on the other extreme, the "profiteering-practices" wreck both the buyer and seller of welding services and it behooves the welding job shop owner who wants to progress, to sacrifice all opportunities he gets for undermining his own business and livelihood. It is very often a good rule to pass up the job which dictates that the price is too high, provided one has figured accurately and knows that quality and satisfaction cannot be sold for less than what has been proposed. Many times the "price-customer" will let the "price-cutter" win and give him the work. When work is lost in this manner it is good policy to follow up the "price-customer" and be on the job, when the work fails and tell him with brutal frankness why it failed. To some, this may seem a rather far fetched, patience trying procedure, but it has proven a sound one, because there are some buyers who will fail to listen to the educational advice which we might term "prevention," while they will very readily and willingly, after being hurt, listen to the advice we will call "remedy."

Be A "Doctor"

High quality materials and skilled welding workmanship are sold at the right price and profit to prevent dissatisfaction either to buyer or seller and they are also a remedy for users who have contracted "welding-experience-sickness."

Inferior quality materials and unskilled or skilled welding workmanship which are sold at a price so low, as to require hurried up slip shod procedure control, are the menacing germs of the welding industry.

The moral is,—be a "doctor" and prescribe prevention and remedy,—or be a "germ" and keep on destroying until your victims become patients of the "doctor."

Proprietor, Storts Welding Co., Meriden, Conn.

WELDING AT THE BRITISH INDUSTRIES FAIR

A circular received from the British Oxygen Company gives an interesting account of their exhibit at the British Industries Fair which was held in Birmingham, England, February 18th to March 1st. The circular states that the outstanding attraction of the exhibit was the demonstration of eight different types of oxygen cutting machines, including a locomotive frame cutting machine, universal machines, and machines for cutting round and rectangular bars and structural steel sections. Demonstrations were also made of cast iron cutting and of hand cutting on plate up to one inch thickness. The exhibit also included display of many different types of welding torches and of a number of types of industrial equipment fabricated by oxy-acetylene welding. A group of experienced technical representatives was maintained at the exhibit to discuss welding and cutting with visitors.

ACETYLENE FLARELIGHTS ILLUMINATE ENGLISH MILITARY CAMPS

An English military organization recently used acetylene flarelights to illuminate their camp, both exterior and interior. A novel light was designed for tent use in conjunction with small cylinders of dissolved acetylene. In a tent forty feet square four lights were sufficient to furnish suitable illumination with reflectors of a special type to prevent shadows. It is stated that anyone within this tent could read and write in comfort. In the hospital tent five lights were used and were so arranged that any section could be left in shadow. Acetylene was also brought into service here for instrument sterilization, a gas ring being supplied from the same cylinder which provided gas for illumination.

Welding Copper, Brass and Bronze*

Welding Characteristics and Strength of Alloys of Copper, Tin and Zinc in Various Proportions, and Procedure for Successful Welding By Torch or Metallic Arc

By Ira T. Hook†

THE list of copper alloys available to the welder is too complex to admit of a comprehensive treatment in this paper. We have, for instance, copper alloying with tin, zinc, nickel, manganese, silicon, aluminum, silver, iron, cadmium, lead, phosphorus, arsenic, bismuth, antimony, mercury, cerium, chromium, cobolt, beryllium, gold, magnesium and oxygen. Some of these elements make a large number of distinctive alloys. Zinc and copper, for instance make no less than fifteen (15) different alloys all in common use under different names and all more or less distinctive in physical and chemical properties. And when we come to combine two or more of these elements with copper we obtain several hundred alloys which are in more or less common use and several thousands more of possible alloys.

Scope of Discussion

For this paper, therefore, we shall confine our attention exclusively to those alloys of copper with tin or zinc or both and their welding characteristics. Even limiting ourselves to these three metals, we run into a large number of possibilities—particularly when we take into account the additional elements necessary for satisfactory mill processing, however, it is our present purpose to confine our attention to alloys of copper and tin, copper and zinc or copper-tin-zinc which have proven satisfactory through the years and it is hoped that it will be possible to describe these alloys in such a way that you will be enabled to recognize the good features of each and likewise its limitations.

Physical Properties of Tin, Zinc and Copper

Let us first get acquainted with the three metals. The physical properties of interest to the welder may be stated as follows:

Item	Copper	Tin	Zinc
Sp. Gravity	8.9	7.3	7.1
Sp. Heat at 0°C	.0936	.0559	.0935
Melting Point °F & (°C)	1981 (1083)	450 (232)	787 (419)
Boiling Point °F & (°C)	4180 (2310)	2900 (1600)	1706 (930)
Lin. Coef. of Expansion °C	.000017	.000023	.000029
Thermal Cond. % of silver	74.0	15.0	27.0
Tensile Strength, lbs. per sq. in.			
As cast	20000	4000	10000
As forged	30000		
As cold worked	60000	5000	21000

Welding Characteristics of Copper, Tin and Zinc

Tin

Tin is a soft white metal of unique properties. It is the only metal available, non-toxic in character, for coating iron and copper food containers. It remains relatively soft and malleable even when severely cold worked but it acts as a hardener on copper making, when used in certain proportions, a glass hard bronze that tool steel will scarcely touch. It is an essential and invaluable constituent of soft solders and aluminum weld rods.

It melts at the extremely low temperature of 450°F but has a remarkable temperature spread between its melting point and its boiling point. If protected from oxidation, it can be heated through the white heat to the melting point of steel before it boils.

It adheres readily to steel, cast iron, copper and brass spreading uniformly over the surface in a smooth impervious coat.

Tin, as such, is of little use to the welder except as a soft solder or tin coat but as will be seen later, is extremely valuable when alloyed with copper—the bronze of antiquity and the modern metallurgist.

Zinc

Pure zinc is a bluish white metal only slightly harder than tin. It is used for coating steel and cast iron, giving the familiar galvanized iron. It is rolled into sheets and drawn into wire but as in the case of tin, the cold working of zinc increases its strength only moderately and it cannot be used to carry more than a light load.

Zinc melts at 787°F nearly twice the value for tin but its boiling point is only 1706°F compared to 2900°F for tin. If heated in the presence of air to a red heat, it burns rapidly throwing off large volumes of zinc oxide smoke which is quite objectionable to the welder. Zinc, therefore, as a pure metal is of no value to the welder but, like tin, it forms with copper an unusually valuable alloy—our familiar brass.

Copper

Copper is by far the most important of the three metals under discussion. This is true both from the welder's standpoint and from the standpoint of industry generally. Its distinctive red color, its combined strength and toughness, its high heat and electrical conductivity and its non-corrosiveness make it unusually valuable. Its melting point of 1981°F is within convenient reach of any of the usual welding methods and yet high enough to make welded copper containers safe for the common industrial processes using heat.

While the copper of commerce is one of the purest of metals, usually running 99.93% pure copper as it comes from the refinery, copper is not simply copper to the welder. It is necessary to go into its life history somewhat before we can predict its welding characteristics. The welder meets with two kinds of copper and there is a marked difference in their respective weldability. This comes about in the following way:

Copper is usually received at the refinery as rough, flat slabs called "anodes." The anodes contain appreciable proportions of metallic impurities. These impurities are taken out most conveniently by the electrolytic process whereby the copper anodes are hung in a plating bath and the copper transferred to a sheet copper cathode by the usual electro-plating process. These cathodes of nearly pure copper are then melted up in a large reverberatory furnace from which they are cast into slabs and bars for making sheet copper, copper wire, etc.

It is this final melting process that gives electrolytic copper its distinguishing characteristic though the copper takes its name from the plating process immediately preceding the final melting. Copper at normal air temperatures is unaffected by the oxygen of the air, but at the heat of the reverberatory furnace an appreciable amount of the copper is oxidized and the oxide dissolved in the molten copper. In order to reduce the oxide, green poles are thrust into the bath, the oxygen going off with the hydrocarbon from the wood. This process is never carried far enough to rid the melt of all of its oxygen. Hence, there is always left in electrolytic copper .03 to .07 of 1% of oxygen in the form of cuprous oxide. It is this small amount of oxygen that is the distinguishing feature of electrolytic copper. This amount of

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*Paper presented at the Welding Conference held at Iowa State College, Ames, Iowa, January 16, 1929.

†Testing Engineer—The American Brass Company.

oxygen has little effect upon the electrical or physical properties of copper products. However, when we come to weld it, the cuprous oxide does give us trouble in two ways.

First, the cuprous oxide has a melting temperature slightly below that of pure copper. Hence when electrolytic copper is heated near to its melting point, the cuprous oxide has already melted and any distortion, occasioned either by shrinkage or mechanical working, will cause cracking.

When the electrolytic copper has been welded, the cuprous oxide (now increased slightly by the welding process) spreads out along the grain boundaries so that a small amount will make a serious line of weakness. Thus even though the weld be quite sound rarely do we obtain a strength of weld greater than 50% of that of the wrought electrolytic copper. The latter has a better distribution of the oxide by reason of repeated heatings and workings at safe temperatures.

A second source of weakness arises as a result of the cuprous oxide but in a different way. If the weld be made in a reducing atmosphere, such as the hydrogen and carbon-monoxide of the oxy-acetylene torch, the cuprous oxide on the contact surface is reduced to sponge copper which of course has little strength.

This action would give us little trouble if the effect were all on the surface. The proper weld rod would alloy with the sponge copper and give us adequate strength. Hydrogen, however, has the faculty of penetrating into the red hot copper several thousandths of an inch. Encountering the cuprous oxide, the usual reducing action takes place and sponge copper and water vapor are formed. The water vapor lacks the faculty of diffusing through the red hot metal that is possessed by the hydrogen. Hence pressure is created tending to disrupt the copper. More than this, the cuprous oxide is usually found along grain boundaries so that as the action progresses, hydrogen diffusing inward and forming water vapor which cannot diffuse outward, wedge-like pressure is formed between grains causing a weakness which persists after the copper has become cold.

Not a few welders are under the impression that if they use the correct weld rod and flux on electrolytic copper sheet, that they will obtain a strong bond. Numerous patents have been taken out on weld rod material with this in mind. Some of these special rods carry appreciable amounts of silver. But whether the electrolytic copper is used as a weld rod or as the base metal or as both, one or the other of the above described weakening effects is apt to obtain. We cannot expect a weld in electrolytic copper to develop more than 15,000 to 18,000 lbs. per sq. in. tensile strength.

There are, however, several exceptions to the above statement. Some tests recently made on resistance butt welds indicate a high strength approximating that of soft wrought copper. In this case the atmosphere is excluded from the weld metal, the latter is under compressive rather than tensile stresses and there is little chance for selective freezing on account of the speed of the process. A strength of from 23,000 to 28,000 lbs. per sq. in. was obtained in the above tests.

Another way in which the trouble with electrolytic copper welds may be avoided is by the use of brazing solders which melt at approximately 1560°F. These brazing solders are frequently used in the granulated form mixed with flux. If the work is carefully done the brazing solder is melted and alloyed with the copper at a temperature which does not disturb the distribution of the cuprous oxide. Hence a good strength is obtained.

Finally, use may be made of silver solder which melts still lower (about 1420°F). This temperature does not affect the distribution of the cuprous oxide. Practically all electrolytic copper wire is silver soldered and excellent strength obtained.

Deoxidized Copper

The refineries discontinue the poling of the molten copper when there is still .03 to .07 oxygen in the bath. They could continue the reaction until all of the oxygen was taken out but to do so would endanger the metal from the absorption of carbon monoxide from the poles or sulphur dioxide from the fuel gases and porous copper would result. For this reason, a metallic or metal-like reducing agent is usually employed.

Also since a much smaller amount of copper in the deoxidized form is used a refinery heat of 200 to 300 tons is seldom deoxidized. Instead a smaller melt of only a few tons is made up of electrolytic copper ingots, deoxidized and recast. The agents usually employed for this purpose are phosphorus, silicon, calcium boride, zinc or cadmium. Since it is impossible to predict the exact percent of oxygen in the heat, an excess of the deoxidizer is used, a small amount remaining in the copper. Calcium boride or the sub-oxide of boron is an exception to this rule. In this case the boride does not alloy with the copper but takes up the oxygen and floats off in the slag.

Copper deoxidized with any of the above elements will weld with greater facility and the weld will have nearly twice the strength of a similarly made weld in electrolytic copper. It is, therefore, advisable in all cases where mechanical strength in the weld is desired to use deoxidized copper. Even when the weld is made in electrolytic copper itself, it is better to use a deoxidized copper weld rod. We can then be sure of the weld metal though we know there will be a surface of weakness a few thousandths of an inch back from the contact plane.

Heat Conductivity of Copper

To the welder familiar with the working of cast iron and steel, one other source of difficulty is encountered in the welding of copper. This arises from its high heat conductivity. This property being nearly the same for both electrolytic and deoxidized copper, we find the same difficulty with both of them on this score. Of course the high thermal conductivity of copper makes this metal unequaled when used in heat transfer apparatus such as radiators, heaters, evaporators, refrigerators, etc.

In welding steel or cast iron, the heat transfer back from the weld is relatively slow. Not infrequently a piece of steel is welded, particularly with the metal arc, and the base metal is not brought up to a discoloration heat an inch back from the weld. With copper this is not possible. The heat flow away from the weld is so rapid that more frequently than otherwise it is necessary to have the copper red hot an inch or more back from the weld before we can secure fusion at the weld. For this reason, it is difficult to weld copper with the metal arc without preheating it. Also for this reason we cannot take full advantage of the high heat concentration in either the metal arc or the carbon arc.

Copper Alloys

When we come to discuss the familiar copper-tin alloys known as "bronze" and the still more familiar alloys of copper and zinc which we call "brass", we encounter a large number of mixtures whose properties cover a wide range. Bronze is the oldest alloy known to man. We have many articles known to be 6000 years old. It has long been valued for its strength, hardness, and toughness and wear resistance as well as for its non-corrosiveness, the beauty of its color and its clear, ringing tones when made into bells. The welder, however, is interested principally in the casting properties of the metal and the density, strength and ductility of the finished weld.

For purposes of identification, the principal bronzes and brasses are noted below with remarks of interest to the welder.

Bronzes

Composition		*Name, properties, remarks, etc.*
Copper %	*Tin*	
95	5	"5% *Phosphor* Bronze.*" Lighter red than copper. Excellent toughness. Melts at 1922°F. Greater strength and hardness than copper. Good wearing resistance.
90	10	"10% *Phosphor* Bronze.*" *"Gun Metal."* Characteristic bronze color—pale gold. Harder than 5% bronze but not so tough. Melts at 1832°F. Excellent wear resistance.

Composition Copper %	Tin	Name, properties, remarks, etc.
80	20	*Bell metal.* Used as cast metal only. Straw white color. Used for bells on account of its beautiful tones. No phosphorus in the bell metal but phosphorus is added if metal is to be used for bearings. Then called "bridge bronze", being used for bearing plates on draw bridges, turntables, etc.
69	31	*"Speculum or mirror" metal.* Hard and brittle. White. Surface can be polished for use as mirror in reflecting telescope. Cast metal only.

**The name "phosphor bronze" is used as the metal is deoxidized with phosphorus. Only a minute quantity of phosphorus remains in the bronze. 5% refers to tin content.*

Brass

There are a large number of brass mixtures in everyday use. In addition to the straight copper-zinc brasses, there is a great variety of similar alloys with various additions of lead, nickel, tin, manganese or iron. The latter are too extensive to be dealt with here so that the following list shows only the principal divisions in the straight copper-zinc series.

Composition Copper	Zinc	Name, properties, remarks, etc.
88 to 93	12 to 7	Great variety of reddish-gold or bronze colored alloys in this group. Handled under various names as "Commercial bronze," "Gilding", "Rich gold metal", "Tombac", etc. Has greater strength, ductility and springiness than pure copper. Melts 1860 to 1920°F.
80 to 85	20 to 15	*"Red Brass."* Sometimes called "brazing brass" because of the fact that it can be brazed by the spelter solders without itself being melted. Of great importance commercially on account of its strength, toughness, ductility, non-corrosiveness. Melts at 1830 to 1850°F.

Composition Copper	Zinc	Name, properties, remarks, etc.
63 to 75	37 to 25	*"Brass".* The more usual brass of commerce. Used for a great variety of purposes calling for a strong, ductile, tough metal of a pleasing yellow color. Melts at 1670°F to 1790°F.
58 to 63	42 to 37	*"Muntz metal".* Brass suitable for hot forging. Used for great variety of purposes, where the cold working is less drastic than the lower zinc brasses. Excellent corrosive resistance to sea water. Melts 1630°F to 1670°F.
50	50	*"Brazing solder".* Used only as a brazing spelter or solder in granulated form. Melts at 1560°F.

Copper-tin-zinc alloys

While there are a large number of copper-tin-zinc alloys, there are only a few which have a wide engineering application and still fewer of special interest to the welder. The others are valued more for their artistic beauty or special application.

Composition Copper	Tin	Zinc	Name, properties, remarks, etc.
88	10	2	*"Gun or Ordnance bronze".* Similar to the 90:10 gun metal except that it is used only as cast metal. Used for bearings.
70	1	29	*"Admiralty metal".* Excellent strength, toughness, ductility and non-corrosive properties. Used for condenser tubes, etc. Melts at 1720°F.
60	1	39	*"Maximum Bronze".* High strength, yellow bronze. Near peak of copper-tin-zinc alloys for combined strength and toughness. Used for great variety of purposes calling for good casting, hot working and non-corrosive properties. Widely used for bronze welding. Melts at 1625°F.

Welding Characteristics—Tin-Copper Bronze

All of the true bronzes are readily welded with any of the methods now in common use. The tin constituent, though it has an extremely low melting point, has such a high volatilization point as to give little trouble on this score. The metal melts and flows freely and quietly. The higher the tin content, up to 30%, the freer flowing will be the bronze. If the tin content gets above 10%, however, the metal is too brittle for general use.

Flux for Bronze

In welding with any of the bronzes, a good flux is necessary. This is needed to protect the molten metal from the air and other gases and also to cleanse it from the oxides which are formed. Fuzed borax is a satisfactory flux except for the fact that it makes a hard close-clinging glass which is difficult to remove from the finished weld. More frequently, therefore, borax diluted with boric acid or sodium carbonate is used. Sometimes ammonium or sodium chloride is added to the flux as a cleansing agent.

Liquation

Some alloys are homogeneous solid solutions such as for instance, alloys of copper and nickel, alloys of copper and manganese and alloys of copper and zinc containing 30% of zinc or less. Other alloys are mixtures of two or more solid solutions containing different proportions of the constituent metals. In some cases, the different solid solutions have different melting points in which event, the alloy does not freeze or melt uniformly as does water but first one and then the other of the two or more solutions. This selective melting causes difficulty in hot working the metal, similarly selective freezing causes trouble resulting in cracks, lines of weakness, or porosity.

This fact is of importance to the welder. He must know whether the metal he is using is subject to liquation or not and the means to avoid trouble if it is. Thus the 10% tin bronze (phosphor bronze) when melted into a weld may show porosity due to liquation if the weld pool is large or the freezing is sufficiently slow. On the other hand, if the metal is cooled quickly, selective freezing is reduced to a minimum and the weld metal will be dense and strong. This fact is of general value. Freezing is a function of time; it is never instantaneous as are some chemical reactions. Hence we can always improve our welds made in or with metals subject to liquation by quick cooling.

The 5% tin (phosphor bronze) is only slightly subject to liquation, the 10% bronze being somewhat more so. When we have a bronze carrying 12% of tin or more, this matter of quick freezing must be keenly watched.

Welding Characteristics—Brass

Brass is readily welded by the oxy-acetylene torch. As in the case of the bronze, a good flux is necessary. Owing to the rapid oxidation of zinc, it is not possible to use brass as a metal arc electrode nor to weld brass sheet with a metal electrode of another metal. Particularly where the brass sheet is thin, the arc must not be allowed to touch the brass. However, very frequently an excellent weld may be obtained by laying a 5% phosphor bronze or a silicon-manganese bronze rod on the joint and fuzing it with the carbon arc. The positive side of the arc springing from the filler rod and the carbon being the negative electrode.

Brass sheet, tubes and shapes may be welded with its own composition weld rod. We obtain thereby a simple fusion weld. However, a still better method is in the use of a lower melting point material in which case the brass need not be melted at all. Thus a high strength yellow bronze, which melts at 1625°F, will alloy avidly with a brass sheet only at a dull red heat. Manganese bronze, an alloy of copper, zinc, manganese and iron, melts slightly lower while the 50-50 brazing solder melts still lower and alloys with equal readiness. Phosphor bronze can be

used if it is desired to match the color of the commercial bronzes.

Brass is not subject to liquation, nor is it at all red short. Its heat conductivity is greater than that of steel but is less than that of copper and we encounter no difficulty on this core.

Welding Characteristics—Copper-Tin-Zinc Alloys

Of the three alloys mentioned in this class, the 60 copper, 1 tin, 39 zinc mixture is the only one of large interest to the welder. The Ordnance bronze can of course, be readily welded when precautions are taken to use a flux and avoid liquation. For purposes where Ordnance bronze would normally be used, as for instance, in heavy bearings, etc., the 10% Phosphor bronze would work better and give similar results. Similarly, while the Admiralty metal is readily welded in the same manner as brass—it is not used as a weld rod as the high strength yellow bronze mixture flows so much freer and gives so much greater strength.

This latter alloy, commercially known as Tobin Bronze, has a large place in the welder's stock rack. It is by far the strongest mixture in this ternary alloy series. It flows readily, shows no excessive swelling or shrinking, is tough and ductile at all temperatures (is not hot short) and it has little tendency to absorb gases but freezes as a dense metal in the weld.

Dr. R. H. Thurston working originally with the U. S. Board from the year 1875 to 1881 on strength of bronzes made an exhaustive series of tests on the strength and ductility of the copper-zinc-tin series. His work is summarized admirably on the triangular diagram shown as Fig. 1.

This diagram makes an interesting study. It includes all of the brasses, all of the tin bronzes, and all variations of either of the three constituents, copper, tin and zinc, from zero to 100%.

The diagram is based on the principle of plane geometry that the sum of the perpendiculars from any point within the boundaries of an equilateral triangle to the three sides is constant and equal to the altitude of the triangle. Hence, the three vertices can be taken as to copper 100%, tin 100%, and zinc 100% respectively and the three altitudes divided into percents. The side opposite the copper vertex will of course be zero copper, the side opposite the tin vertex will show only varying proportions of copper and zinc, or brass in other words. Similarly, the side opposite the zinc vertex will show only proportions of tin and copper or the true bronzes. The location of any composition of these three metals can be shown in the triangle by a point located by the proper percentages measured from the respective sides.

If we make up a large number of cast bars and locate them in the triangle, as was done by Dr. Thurston, we can write the test results on each point. Contour lines can be drawn through points of equal value as shown in the figure.

Several things are at once apparent from a study of this figure: (1) Copper must be present 42% or more to have a strength greater than a nominal 15,000 lbs. per sq. in. (2) 10% of tin is equivalent to 30% of zinc in raising the strength of copper. (3) With 13% of tin, copper-tin alloy reaches its greatest strength about 47,500 lbs. per sq. in. (4) With 42% zinc we obtain the strongest brass at approximately 52,000 lbs. per sq. in. (5) In the copper-tin-zinc mixtures, we obtain a peak strength at tin 3%, zinc 42%, copper 55%.

The ductility is not shown on the diagram but if we draw nearly a straight line from tin 10% copper 90% to zinc 45%, copper 55% we will find the group of alloys combining the greatest strength with good ductility. The alloys grouped about the line from tin 25%, copper 75% to zinc 55%, copper 45%, are extremely hard and brittle and for this reason have limited usefulness.

In 1876, some five years before the publication of Dr. Thurston's work, John A. Tobin of the U. S. Engineering Corps patented the alloy known as Tobin bronze. This is a high strength yellow bronze of approximately 60% copper, 1% tin, 39% zinc composition. As will be seen, Tobin bronze is very close to the high peak of the diagram, a little of the strength being sacrificed for greater ductility.

Summary of Welding Procedure

In the use of these alloys, we must determine whether a fusion weld is desired (where the base metal is melted simultaneously with the weld rod) or whether we shall have a weld in which the base metal is not melted, the connection being made by the use of a filler rod having a lower melting point. When we are welding steel with steel or cast iron with cast iron, a fusion weld is imperative. The molten steel or cast iron weld rod will not adhere to the steel or cast iron base if the latter be not fuzed.

Quite a different condition prevails in the use of the copper alloys. Many times the strongest possible weld is obtained when the weld rod is fuzed onto the base metal when the latter is only a dull red. Viewed from the standpoint of effect on the base metal, this is a very desirable condition of affairs. It is well established that the lower we are able to keep the welding temperature on the base metal, the lower will be the change in its

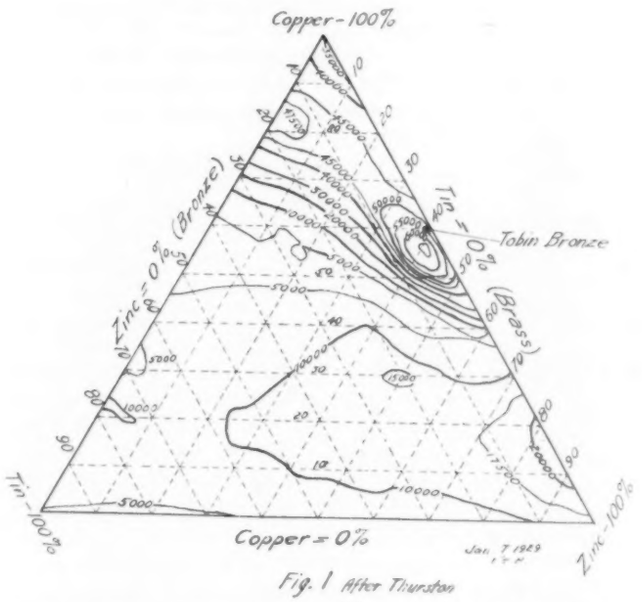


Fig. 1 After Thurston

Contour Lines Are Drawn Through Points of Equal Strength for Alloys of Different Proportions of Copper, Tin and Zinc. All Possible Proportions Are Included Within the Triangle.

structure, and the less likelihood of distortion and shrinkage strains or cracks. For the same reason, it is often possible to make a weld with one of the copper alloys without preheating the base metal whereas preheating would have been a prime essential if the base metal had been fuzed.

We have shown that any of the copper-tin-zinc series of alloys are readily weldable when used as a base metal. A flux is necessary. The metal arc and carbon arc as well as the oxy-acetylene methods are applicable to welding copper or copper tin alloys but only an indirect arc or the oxy-acetylene method are applicable to use with the zinc alloys.

When used as a weld rod, the deoxidized copper or the tin phosphor bronzes may be used by any method including the metal arc. But here again only the oxy-acetylene or the arc torch may be used on the alloys containing zinc.

As for the strength of welds in these materials, we have shown that a weld in electrolytic copper is not usually greater than 15,000 to 18,000 lbs. per sq. in. even though we use a special high strength weld rod, whereas welds in deoxidized copper run from 24,000 to 28,000 lbs. per sq. in. using of course, a deoxidized copper or bronze weld rod. Welds using the phosphor bronzes run from 25,000 to 35,000 lbs. per sq. in. while welds made by the high strength yellow bronzes run from 30,000 to 45,000 lbs. per sq. in. Any of these materials are equally applicable to cast iron, malleable cast iron, steel and non-ferrous alloys.

Arc Welding Nickel-Chromium Alloys

The Most Satisfactory Practice in Welding These Resistant Alloys Is to Reverse the Polarity and Buck the Current. Heavy Single Beads Should be Avoided

By George A. Maurath

THIS subject has been touched by very few men in the industry. It is now possible to make a sound homogeneous weld on the following metals:

18	Chrome	8	nickel
20	"	25	"
20	"	35	"
20	"	50	"
20	"	80	"

This is done by processing the rods which accomplish the

Fig. 1. Top: Cross Section Cut Through 25 Successive Welds. Lower Left: Double Bead Bent Through 180° Over ¾ in. Radius. Lower Right: Single Bead Bent Through 120° Over ¾ in. Radius.

following results: build a reducing atmosphere around the arc which excludes oxygen and prevents oxidation; scavenge the injurious gases, and lay a protective coating over the weld at the same time.

The process for welding the different alloys varies somewhat, as high nickels are very resistant, requiring a different

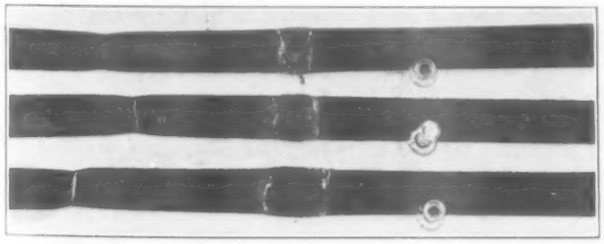


Fig. 2. Specimens of 18-8 Chrome-Nickel Alloy Welded With (Top) a Commercial Coated Wire and (Center and Bottom) With Maurath Coated Wire, With Single and Double Beads.

and heavier coating over a low nickel content. We have been able to make welds on 65 nickel and 20 chrome which has withstood hundreds of hours in a carburizing furnace in one of the prominent motor car manufacturing plants. This is shown in Figure 4.

These boxes are made of two different metals, the bottom and lid rim being cast high nickel content and the side and lid of a lower nickel rolled material, making a high saving of heat losses over the solid cast boxes by being able to weld these metals successfully.

The welds made by the above process are giving perfect satisfaction in a good many of our leading industries, as the metal laid is practically identical with the metal welded, and free from porosity and the general blowy appearance of the former attempts at welding these metals.

We have obtained excellent results by using A. C. or D. C. welders, but the best results have been obtained by the use of D. C. machines having both variable voltage and amperage controls.

When welding with D. C. the best practice is to reverse the polarity, also to buck the current. Bucking the current is very important, and the location of the ground should be watched in order to get the best results. As the metals mentioned are very resistant to electric flow, the arc will go wild if for no other reason than resistance in the plate. Work-

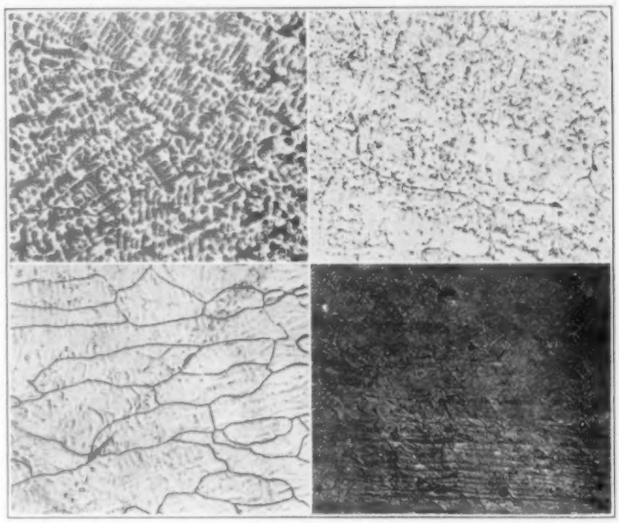


Fig. 3. Upper Left: Deposited Metal in Single Weld x 100. Upper Right: Second Bead of Double Weld, Similar to Single Weld. Lower Left: First Bead of Double Weld, Showing Smaller Grain Due to Annealing Effect of Second Weld. Lower Right: Section Through Base Metal Away From Weld, Showing Fine Structure.

ing on 18-8, which is our most common alloy, the following current values have given excellent results:

5/32 on 1/16 plate use from 40 to 60 Amp, 30-40 V open circuit
5/32 on 1/8 plate use from 75 to 125 Amp, 40-50 V open circuit
1/8 on 3/32 plate use from 150 to 175 Amp, 50-60 V open circuit

The 1/4" rod should be used only on extremely heavy work where it is a matter of building up a section, such as a casting or other heavy plate work. Use 225 to 300 Amperes, 70-80 Volts.

It is possible to weld straight 14% to 20% chrome, no nickel, and get a sound homogeneous weld where it is possible to anneal after welding, but it is not recommended as the structure is martinsitic and will show a brittle range in the area adjacent to the weld.

In laying heavy bead, on 1/4", 3/8" and 1/2" plate, the best results have been found by laying several light beads or layers instead of one large bead as each layer will anneal the preceding layer resulting in a first class heat treatment, stopping excessive grain growth and giving greater ductility.

President, Maucrath, Inc., Cleveland, Ohio.

Care should be taken about removing the protective slag from each layer by scraping, wire brushing, peening or sand blasting before laying succeeding bead. Also the protective coating as laid will snap lose from the weld in cooling and the welder should wear plain goggles under his hood, as these particles of slag carry a good bit of heat and might cause injury to the eye.

Following is a summary of a report made by one of the leading manufacturers of stainless steel, analysis 18 chrome, 8 nickel, with the Maurath coating.

Samples of 18-8 plate, 10 gauge, 1" x 8" were welded longitudinally with one and two beads for bend tests to determine the ductility of the weld. These were then bent thru 120° and 180° respectively over a ¾" radius without fracture in the weld proper or base metal, showing the deposited metal to be soft and pliable.

Another sample was welded to determine the degree or number of inclusions trapped when depositing successive beads, as in welding heavy plates.

In this case a total of 25 beads were laid down one over

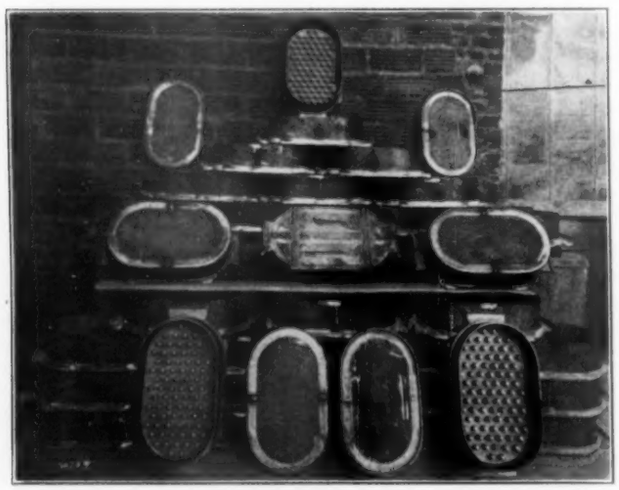


Fig. 4. Welded Carburizing Boxes. Bottom and Lid Rim Are of Cast High Nickel Content and Sides and Lid Are of Lower Nickel Rolled Material.

the other and three sections cut transversely thru same. These in general showed up very good, one being absolutely free from inclusions while the other two exhibited a couple of small holes, but considering the total cross section and large number of beads these are negligible. The Brinnell hardness on the surface of the double bead was 179 and at the center on one of the cross sections 228.

The above cross sections and bend tests are shown in Figure 1.

Samples were also welded with our own coated wire as well as with the Maurath coating, and machined for standard tensile tests these pulled as follows:

Weld	Bead EL	US	5 elong 8"
18-8 wire with our coating, single.....	52700	101100	44.5
18-8 wire with Maurath coating, single	50500	101100	38.5
18-8 wire with Maurath coating, single	52500	102200	41.

The above results are all approximately the same, and all the fracture occurred from two to three inches away from the weld in the plate itself. These tests are shown in Figure 2.

These welds were also examined microscopically to compare with the base metal. These results are shown in Figures 3, 4, 5, and 6.

The report concludes: "this coating was tried by welding in our own plant and we found it very free flowing and easy to maintain an arc. Also test shows the average welder can weld with this coating with very little instructions. The weld tests as shown in this report were entirely satisfactory."

WESTINGHOUSE ELECTS CHAIRMAN OF BOARD

Andrew Wells Robertson of Pittsburgh, president of the Philadelphia company, was unanimously elected chairman of the board of directors of the Westinghouse Electric and Manufacturing Company in a meeting of that board, held in its offices at 150 Broadway, New York City, January 16.

Mr. Robertson is of Scotish parentage. He is in his 49th year. He was graduated from Allegheny College, Meadville, Pa. in 1906 with a degree of AB and from the Law School of the University of Pittsburgh in 1910 with a degree of LLD. After practicing law in Pittsburgh, he became General Attorney of the Philadelphia company, which, with its affiliated companies operated all of the electric light and street railway properties and most of the gas properties in the Pittsburgh disrict. After having served for several years as Vice President of that company in charge of public relations and the Law Department he was elected as its president in 1926, which office he has held since.

In addition to his important business activities, Mr. Robertson has been prominent in public affairs in Pittsburgh, especially in connection with the Pittsburgh Chamber of Commerce.

Mr. Robertson will withdraw from his other business activities and devote his entire time to the Westinghouse Company. For the present his official headquarters will be in Pittsburgh.

Henry Bedinger Rus, president of the Koppers Company, and an official and director of many other companies, was elected a director of the Westinghouse Electric and Manufacturing Company at the same meeting. His home address is in Pittsburgh, and his business offices are in the Union Trust Building. Mr. Rust will continue to serve as head of the Koppers Company.

Since the death of Mr. Guy E. Tripp in 1927, the chairmanship of the board has been temporarily held by Paul D. Cravath, general counsel of the Westinghouse Company. Mr. Cravath will continue in the capacity of general counsel.

ARMCO PUBLISHES INTERESTING BOOKLET ON NEW CONTINUOUS SHEET MILL

The story of the development of the continuous process of producing sheets of 16 to 22 gauge metal, the pioneer research work required in the metallurgical and design aspects of the problems confronting the engineers, and the eventual development of a radically different principle from that of the old method of rolling sheets, is told in a very interestingly written and illustrated booklet of twenty-four pages, prepared by The American Rolling Mill Company, Middletown, Ohio.

To quote from the booklet: "The continuous process is just what the name implies—*continuous* instead of many different segregated operations, each with its individual function to perform. The continuous process begins with the hot ingot at the blooming mill and moves forwad in a straight line through mills and furnaces acting successively on the product.

"Beginning as an ingot weighing 11,000 lbs., the metal travels in a straight line for some 800 feet and is delivered at the end of the line as sheets, at the rate of over a ton a minute. The approximate daily capacity of a continuous mill unit is 1,400 tons, requiring 1,700 tons of ingots. So rapid is the speed of the moving pieces of hot metal that one must move very rapidly to keep up with the metal as it fairly shoots down the long line of operation.

"One can readily grasp the tremendous significance of such a change in method of manufacture. It means greatly increased production at lower cost—a characteristic trait of industrial America that has made it the envy of the world."

Hospital Addition Erected Silently

Patients Are Undisturbed and Operations Are Performed While Steel Structure Is Fabricated in the Field by Arc Welding

IN WHEELING, West Virginia, surgeons, physicians and nurses attend their patients in the Ohio Valley General Hospital undisturbed by the erection of steel framework for the new addition to the present hospital building. There is no rat-a-tat-tat from the riveting hammers reverberating through wards, clinics, and dispensaries,—the electric arc fuses member into member, silently. Fifteen feet from the operating table a welding operator strikes an arc, welds beam to column while muzzled white-frocked surgeons perform their delicate tasks in quietness.

One hundred forty beds will be added to the hospital when this new six story, quarter-million dollar addition is completed.

Fig. 1. All of the Field Fabrication of This Structure Was Done By Electric Arc Welding.

The present building forms three sides of a square, one side being six stories high, the other two sides five storis high. The new addition encloses a court, and brings all sides of the hollow square up to a height of six stories. The building was designed by Architect Charles W. Bates of Wheeling, and is being erected by R. R. Kitchen Company of the same city.

While the shop fabrication of the structural steel is of riveted construction, the electric arc welding process was used to make all field connections, the members being held prior to welding by field bolts. The illustration, Figure 2, shows a typical beam to column connection. The intermittent fillet welds which secure the webs of the beams to the column take the place of connecting angles. This eliminates considerable shop and field fabrication which would have been necessary to make such a connection of riveted construction.

Another interesting detail of welded construction is the splicing of columns as shown in Figure 3. The splice plates were riveted in the shop to the lower column section. About two-thirds of a splice plate was used to make the riveted connection which required six rivets. The remaining or upper third of the splice plate was punched for two field bolts which hold the upper section in place while fillet welds were run around the edges of the splice and filler plates fusing them into the flanges of the upper column section. The photograph, Figure 3, also illustrates the method employed in connecting the exterior beams and tie beams to the exterior columns. Intermittent fillet welds 3 inches long, tie the 15 inch I-beams into the columns.

Where openings occurred in the exterior walls lintels to span the top of openings are welded to the bottom of the exterior beams as shown in Figure 4. To secure the plate lintels to the beams by the traditional riveted method would have required considerable more laying out, in addition to punching the beam flanges and plates and driving the rivets. By the use of C-clamps the lintel plates were held in position while one welder operator

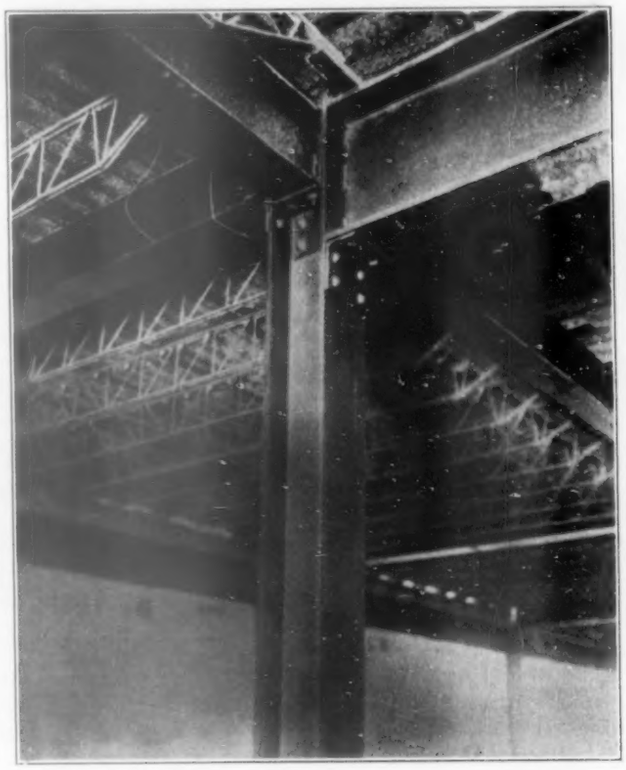


Fig. 2. Detail of Welded Beam to Column Connection.

fused steel into steel with the electric arc in one-third of the time required for riveted fabrication.

Welded bar joists are used to carry the 2-inch concrete floor and roof slabs. These joists are welded in place at each end to their supporting beams. This improved method of securing the floor joists gives increased stiffness to the entire structure. To give the joists increased lateral stiffness a ⅜-inch rod is laid across the bottom chords of the joist in the center of their span and welded to each joist. This increases the rigidity of the joists to a far greater extent than if they were bridged in the usual way with wire.

The 150 tons of structural steel required for the framework of the new addition was erected by the general contractors. Two portable motor driven Lincoln "Stable-Arc" welders of 300 amp. capacity were used to supply the current for welding.

While this steel structure is not entirely are welded due to the shop fabrication being of riveted construction it represents an intermediate stage of design in steel structures between the traditional all-riveted construction and the modern all welded construction. Mr. R. R. Kitchen, head of the construction company which bears his name, estimates that the cost of arc welded steel erection will not exceed, and in the final analysis may

prove to be even less than the cost of a field riveted job. Such results obtained from actual practice should encourage those who have been a trifle skeptical of the strength and economies of all welded steel construction to attempt to obtain at least a few of the advantages which the new method offers. The use

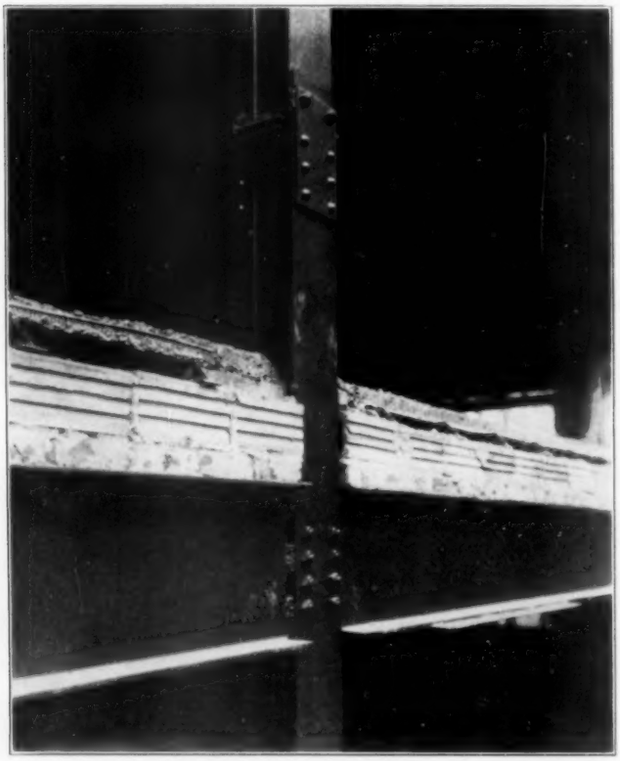


Fig. 3. Detail of Column Splice and Exterior Beam to Column Connection.

of a combination of riveted and welded construction will give experience and promote confidence in the electric arc welding process. As experience and confidence is gained the use of welded construction will increase until the transitional stage between riveted and welded construction will have ended and the efficient modern all welded steel construction will be recognized as standard practice.

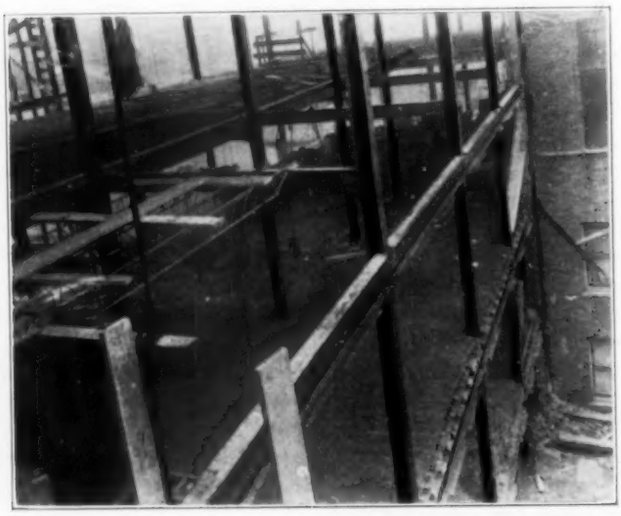


Fig. 4. Lintel Plates Were Welded to the Bottom of Exterior Beams.

Heretofore the cost of additions to department stores, office buildings, hospitals, hotels, telephone exchanges and similar buildings has not been reckoned solely by the actual cost of labor and material but has by the force of necessity included the cost of the loss of business incurred due to the disturbing noise created by the field riveting of structural steel. In many cases this loss has exceeded the actual labor and material cost of the building. Since the introduction of the electric arc welding process into the field fabrication of structural steel this loss of business during building operations has been reduced to a negligible amount due solely to the silent erection of steel which has been made possible by arc welding.

Illustrative of the value of silent erection is an incident

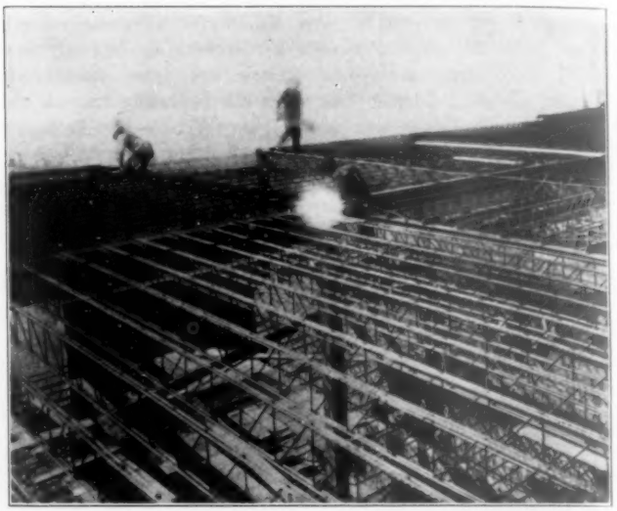


Fig. 5. Welding Floor Joists to the Supporting Beams.

experienced during a visit to the scene of building operations at the Ohio Valley General Hospital, An abdominal operation performed by two surgeons was carried through to completion in almost absolute silence while only fifteen feet away a welding operator was making beam to column connections with the electric arc. Dentists occupying offices in the Rose Building, Cleveland, Ohio, have filled teeth while within a few feet of their open windows welding operators fused steel to steel with the electric arc. Such delicate tasks could not have been performed during building operations if riveted construction had been employed. Taking into consideration the immeasurable value of silent erection, arc welded steel construction offers an economy that cannot be approached by any other method of joining steel.

NEW CONTRACT WELDING FIRM IN DAVENPORT, IOWA

A new firm known as the Welders Contracting and Engineering Company has been formed in Davenport, Iowa, with Mr. Greene as General Engineer and Mr. E. A. Lange as Associate Engineer and Architect. Mr. Greene has the management of the firm and brings to it 18 years of experience in the development of oxy-acetylene welding. He plans to devote his time and effort to the development of pipe welding in buildings and structural welding, although the firm is equipped to do all kinds of commercial job welding. Mr. Greene's former connections have been with the Air Reduction Sales Company and the Bettendorf Oxygen-Hydrogen Company. During the World War he had a government position in charge of welding on steel ships and instructing men for that kind of work. He has recently secured a patent on a torch guide and support for welding and cutting torches, which enables the user to cut in any direction and to operate the torch easily in difficult positions.

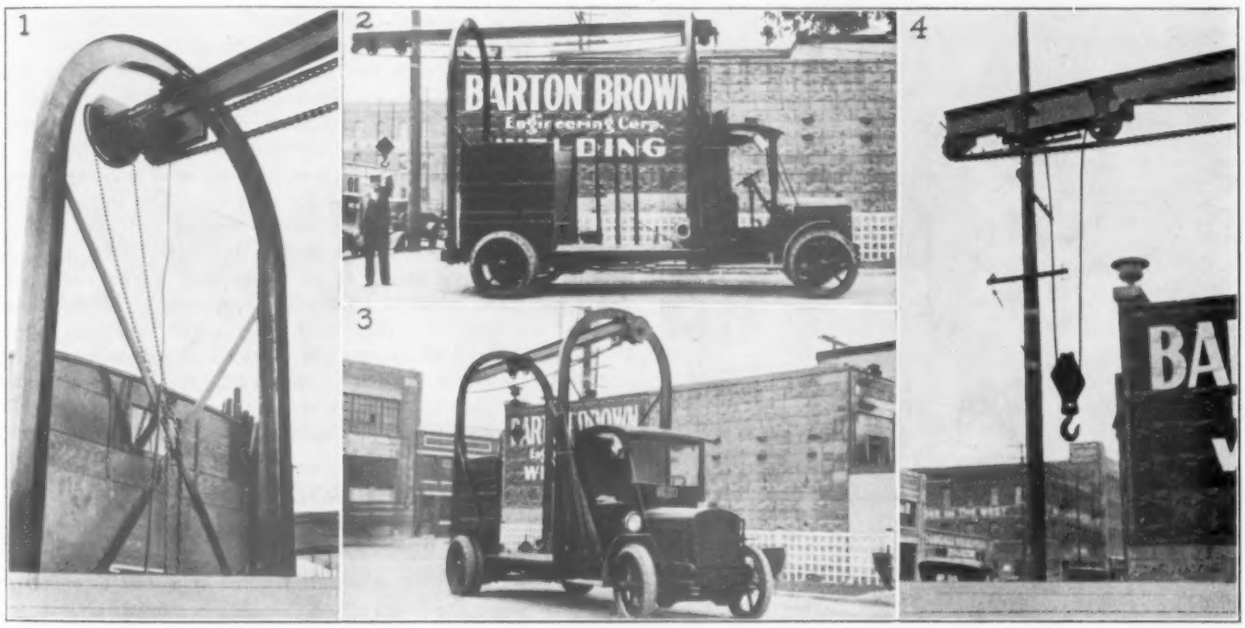
The new company is allied with the Heinlein-Hine Manufacturing Company of Burlington, Iowa, who are structural iron workers. They plan to have the new shop open for business soon after April First.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

WELDING CONTRACTOR DEVELOPS TRUCK FOR PUBLIC UTILITIES

One of the most interesting fields of usefulness of the job welding shop is the fabrication of special equipment for local concerns. It very often happens that there is a demand for types of equipment which are not manufactured anywhere and which would be exceedingly costly if they were made up specially in any other way except by welding. The Barton Brown Engineering Corporation of Los Angeles, is one firm of welding contractors which has a wide reputation for ingenuity and skill in fabricating all kinds of plant equipment from welded steel. The phototgraphs in the accompanying illustrations show different views of the special truck which they recently produced for a public utility company. The principal purpose of this truck is for bringing in parts, supplies, equipment, machinery, etc., which are used in the conduits throughout the city territory. The use of ordinary cranes for the handling of heavy materials in such places often means handling the same piece several times and is apt to require the presence of several laborers for long periods of idleness in order that they may be available for duty when the material actually has to be handled. The truck illustrated carries a traveling crane which extends far enough from the back to make it possible to drop the hook down into the manhole to pick up a load; pick it up and set it on the truck all with one handling. The same is true, of course, of unloading operations. This special construction is all-welded. Several of them are in service and are giving excellent satisfaction because they are saving the public utility company considerable money on their labor costs.



All-Welded Truck Equipped With Traveling Crane for Loading and Unloading Heavy Materials Direct Between Truck and Underground Conduits.

AN EMERGENCY TEST

By S. W. Fransson

R-r-r-r-i-n-g!—

"Can you make a cylinder of $\frac{1}{16}$" sheet steel, disc top and bottom, 2¼" P.T. plugs in top and have it ready 3 o'clock this afternoon?"

"Yes, but how about test?"

"Oh yes, must be tested to stand 300 lbs. Hydraulic pressue."

"Oh yes, we can. We will have it for you but how about a test sheet?"

"No, we don't need it. Just so the tank will hold 300 lbs. without busting—it is 9 o'clock now and you better rush."

"Oh yes."

Well, we rushed. A sheet of metal was rolled up and the seam acetylene welded. Two ⅛" thick discs were cut out with a torch, heated and shaped, one welded in for the bottom and one after two ¼" malleable pipe fittings were welded in with cast iron filler, and then the head was welded to the cylinder, completing the job.

Looking it over, we were rather pleased with it but one thing remained to be done and that was the "test." Having no apparatus, and no time to go to any place with it, it seemed hopeless until a happy thought came to our minds from somewhere. In a few minutes, our 60" long and 7" in diameter cylinder was full of water, a 500 lbs. spare gauge, which we had, was screwed in one of the openings and a plug in the other, taking care to have the water up to the top. After drying the cylinder, we placed it on a sheet of white clean cardboard, and then played a torch around the top about 3" below the rim. Doubting the result,

the watchers were expressing their opinions in a language not befitting a Sunday School picnic, but then the hand of the gauge started to move slowly away from zero. Another few minutes passed, and it showed 100 lbs., then 200 lbs., then 300 lbs. After the torch was shut off, a pail of cold water was poured over the top stopped the gauge at 350 lbs., and it was on the dock, going to its destination.

Oh yes, the cylinder held; and when the boss wanted to know how it was tested, he was told 350 lbs. hydryalic pressure, and here he will find out how we did it.

A JOB FOR THE PLANT WELDER

When a cast iron frame in a barium plant broke recently, it looked very much as if the mill in question would suffer a serious loss. This frame was fractured in eight places and as it was a part of an obsolete machine, replacement was impossible.

Cast Iron Frame of Obsolete Machine, Broken in Eight Places, Quickly Repaired By Welding and Put Back Into Service.

The factory manager had modern ideas, however, and anticipating just such an occurrense he was fully prepared to meet the situation when it arose. He maintained, from the start of his services with his company, that the establishment of a central welding shop, presided over by an all-around welder, was cheap insurance and a part of progressive factory management.

The plant welder quickly sized up the situation and decided that it would be a comparatively easy job to repair the damage. Preheating the entire casting was of course, necessary. The broken parts were lined up in their proper places and a preheating furnace, built of loose firebrick, constructed to enclose the entire frame.

After a charcoal fire had been built and the piece brought up to a uniform heat, the operator began his welds. Asbestos paper was used to cover the casting during this operation and this was barely moved to admit the welding blowpipe and allow the operator to work. A good quality cast iron rod and standard make of flux were employed. The job was completed within a few hours and allowed to cool slowly in the dying embers. Examination of the finished repair showed excellent results and the frame was soon back on the job. The accompanying illustration shows the chalk marked welds proudly exhibited by the plant welder.

PORTABLE WELDING SHOP ARRANGED FOR QUICK ACTION

Mr. Pallady, proprietor of the Pallady Welding Company, Portland, Oregon, has developed a unique idea for the portable welding shop. The truck which is illustrated herewith carries a gasoline engine driven arc welding set and also oxy-acetylene welding equipment, including the gas cylinders. The photograph shows the mounting of the acetylene tank on one side of the truck and the oxygen tank is mounted in a similar fashion on the other side. An especially interesting feature of this arrangement is a method provided for taking care of the gas hose. There is a double reel in the rear of the arc welding machine made up by welding together four discarded automobile steering wheels and a piece of ordinary pipe. When this outfit arrives on the job there is no time lost in untangling the hose. The desired length is quickly run off the reels and when the job is finished it is wound up quickly into place. This not only saves time in getting the apparatus into operation but also saves a great deal of wear and tear on gas hose because it is only necessary to unwind the amount required for each job. The Pallady company specializes in such jobs as heavy logging and mill equipment, automobile equipment, automobile cylinder blocks and crank cases, and aluminum and alloys. They have worked out a number of ingenious methods of handling particularly difficult welding jobs and they advertise "If Pallady Can't Weld It—Throw It Away." Mr. Pallady was one of the first job welders to establish a business in the Pacific northwest. He has been operating a successful shop in the oil fields of the Central South for several years and recently opened up a new shop in Portland.

Completely Equipped Portable Welding Shop Ready For a Rush Call.

HOW SILVER SOLDERS ARE USED IN MAKING WIRE

By R. R. Shuman

When you see a bright shiny section in a steel or copper wire, you probably don't know that that section consists at least partly, of silver solder. Wire is drawn from rods that are rolled for the purpose by the copper and steel rolling mills. Wire drawing is a continuous process and the wire, in spools or coils must be one continuous strand.

As rod-lengths are limited by the rolling process, the successive rods that are fed through the wire-drawing dies must be brazed together. This is done by splicing the silver solder: silver solder being used because of its strength, and ductility and because it "works fast."

In this way heavy rods are, by successive drawings, brought down to wire as fine as two one thousandths of an inch or less.

The same process is used in joining lengths of wire for redrawing the lighter gauges, and for joining sections of wire that break during the drawing process.

In welding rods or heavy wire, the ends are beveled, and, the bevels are held tightly together in a vise and subjected to a brazing heat, either from an electric arc or an oxy-acetylene or air-gas torch. In some cases a clipping from a thin sheet of silved solder is inserted between the two beveled faces, and in others molten solder is applied from a strip or wire held in the torch flame.

An interesting operation is that of joining lengths of "copperweld" wire, a wire with a steel centre and copper envelope.

While the two metals are practically homogeneous their coefficients of expansion differ materially. Another complication is the fact that the copper exterier fuses at 1980° F, and the steel core at 2550 degrees. Yet it has been found that the use of silver solder at about 1400°F makes a perfect joining of both metals at once; a joint that holds through successive cold-drawing operations.

Silver solders are always used in the manufacture, as well as in the splicing of wires and cables for carrying electricity, because of their high conductivity-factor. The telegraph, telephone and power companies also recognize the corrosion-resisting property of silver solders, which means permanence under exposure to weather.

RIVETING IN A BUTT WELDER

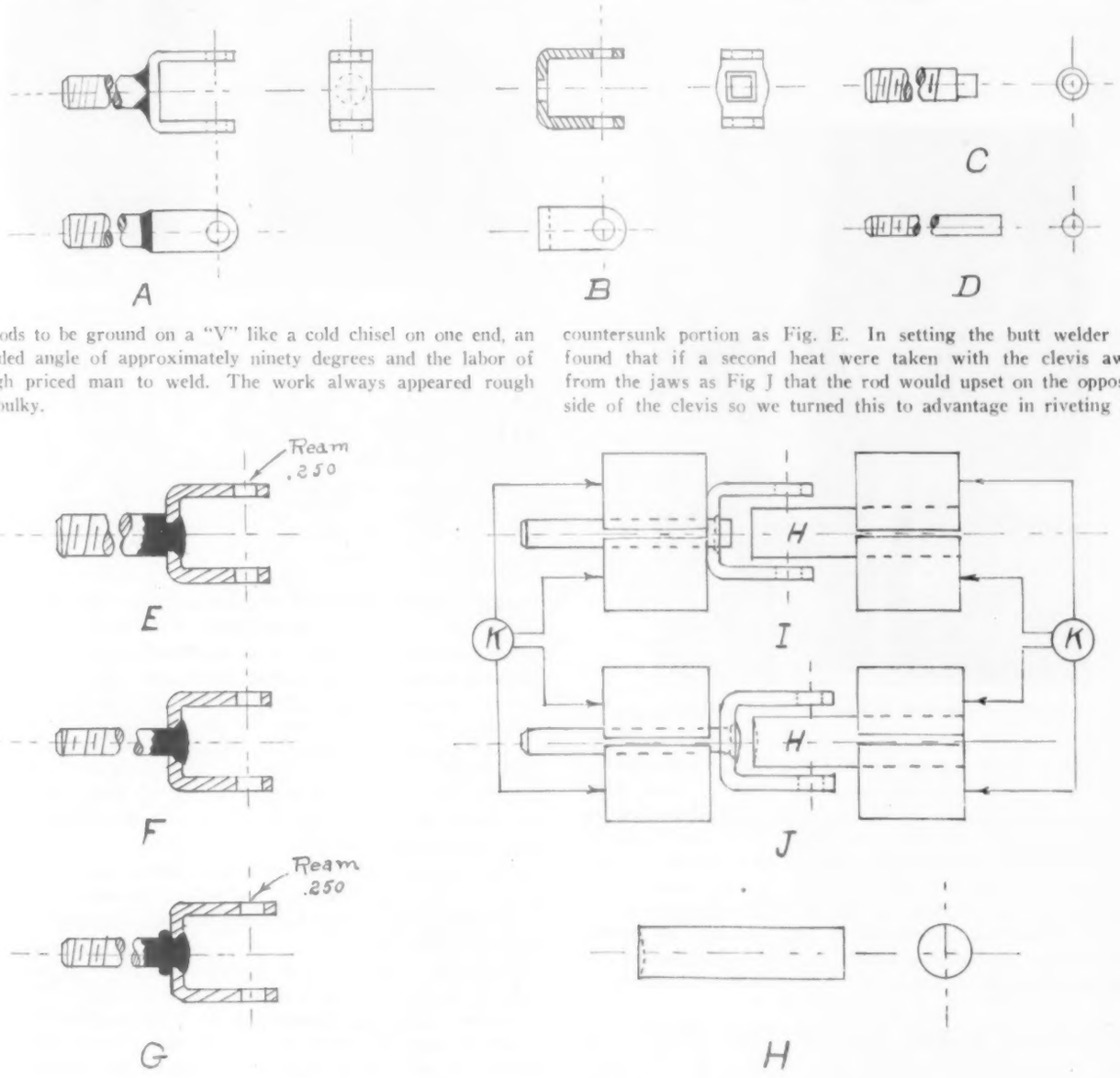
By George T. Kerr

We are utilizing a butt welder to heat and rivet the rods Fig. C or D to the clevis Fig. B. We have always acetylene welded these parts as shown at Fig. A, the acetylene welding requiring the rods to be ground on a "V" like a cold chisel on one end, an included angle of approximately ninety degrees and the labor of a high priced man to weld. The work always appeared rough and bulky.

The clevis Fig B is made of ⅛x½ inch cold rolled steel cut length and the ends rounded in a punch press. They are then formed to shape a ¼ inch square hole pierced and countersunk in the center. This bulges the side slightly, then the two ¼ inch round holes pierced about .005 inch under size.

When we changed to assembling in the Butt Welder the rod Fig. C was changed, the end being turned down to ¼ inch diameter by ¼ inch long as at Fig. C. The ¼ inch square hole was added to the clevis Fig. B.

The procedure for assembling Fig. E, the rod that is shouldered back to take the clevis Fig. B, is to clamp the rod in the butt welder jaws K and let the clevis come back against the jaws as shown at Fig. I although in this view the rod shown happens to be ¼ inch diameter. The anvil H is brought in contact with the work and the electrical circuit completed. When the rod end had reached a bright yellow the electrical current is broken and the anvil brought firmly forward upsetting the end of the rod and forcing the excess metal into the square corners and filling the countersunk portion as Fig. E. In setting the butt welder we found that if a second heat were taken with the clevis away from the jaws as Fig J that the rod would upset on the opposite side of the clevis so we turned this to advantage in riveting the



Diagrams Showing Method of Joining Rod to Clevis by Butt Welding.

The rods Fig. C and D are either ¼ or ⅜ inch in diameter and anywhere from 1 to 24 inches long, threaded on one end. They are cut off by a punch press and threated by a screw machine, in the case of Fig. C. One end is cut down to ¼ inch diameter by ¼ inch long.

¼ inch rods. The procedure is: to clamp the rod in the jaws K as shown in Fig I using a stop on the butt welder against the back end of the rod to govern the length of rod to protrude through the clevis, we then heat and upset as shown in Fig. F. Now we move both clevis and rod forward ⅛ inch leaving a gap

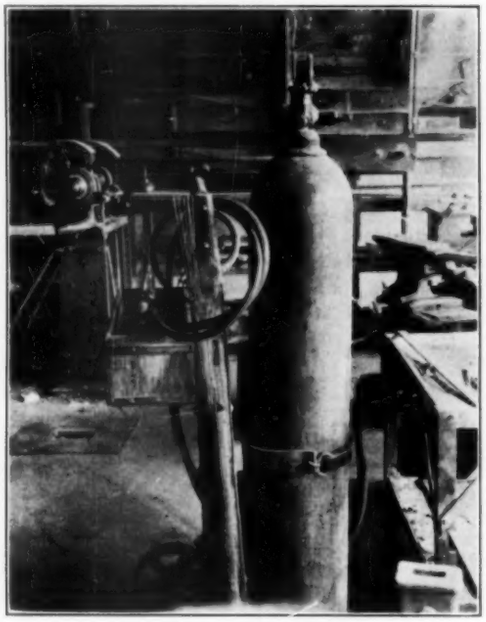
between the clevis and the jaws as shown at Fig. J. The anvil H is brought in contact and the electrical circuit completed. When a bright yellow heat is obtained the circuit is broken and a firm pressure on the anvil upsets the rod back of the clevis as shown at Fig. G.

We used a piece of ½ inch copper rod at first but it required so much dressing that we changed to Elkonite, the anvil shown at Fig. H. The copper anvil required dressing about every fifty rods and the Elkonite completed over two thousand upsets before requiring dressing. The anvil is a piece of Elkonite ½ inch diameter by 2 inches long and is simply clamped in the butt welder jaws. Removal for adjustment or dressing requiring very little time. After assembling as shown at Fig. E or G we line ream the ¼ holes to size. The difference in cost between welding and electric riveting is .05c each, and a much better appearing job is obtained by the new method.

A HANDY PORTABLE OUTFIT

By J. C. Coyle

This acetylene welding outfit is rigged for quick and easy moving to any part of the shop. The tanks are strapped to the front of a two wheel truck, resting on a projection at the foot. A holder for welding rods is made from light 2 inch tubing,



A Handy Arrangement of Oxy-Acetylene Equipment.

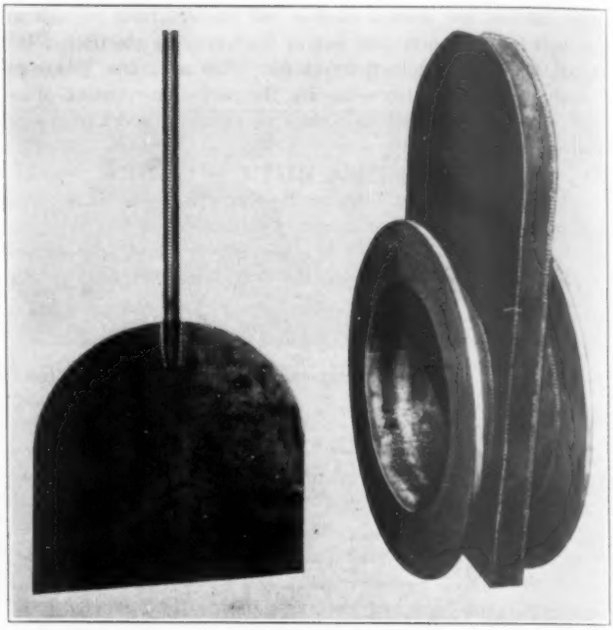
closed at the bottom end and fastened to one handle of the truck by screwing a bit of one side of the tubing, which is straightened out, to the wood. A wooden box, 6 by 6 by 24 inches, bound with metal and bolted to the under side of the handles near the top, carries goggles, tips and other things which may be needed. The tips are kept in a neat row, inserted in a number of small holes bored in a two inch strip of lumber, a short distance from the bottom of the tool box, on one side. A metal hook at the left of the truck is used on which to curl the hose when moving, and a small fire extinguisher is kept in a light metal bracket just below it. When in motion the torch is placed in the tool box.

SIMPLIFIED BLAST VALVE CONSTRUCTION

Until recently all valves used on blast lines for blue water gas and carbonated gas plants have been made almost entirely of cast iron. While such valves have proven to be satisfactory in performance, they are exceessively heavy for their size and require much labor in handling and installing.

Typical of successful manufacturers who are constantly striving to improve their products and lower production costs. The Gas Machinery Company, Cleveland, Ohio designed a blast valve of arc welded steel construction whose cost is less than the traditional cast iron valve and whose weight is almost half of its cast iron predecessor. A 16 inch blast valve made entirely of steel joined by arc welding is shown before assembly in the accompanying illustration.

The valve housing consists of a section of 16 inch steel pipe which is inserted through the gate case and welded in



Cost of This Leak-Proof Blast Valve Is Less Than Previous Cast Design, and Weight Is Cut in Half.

place. Connection flanges are cut from steel plate and are welded to the ends of the pipe section. The gate slide is then cut through the pipe section with a gas torch. The gate itself consists of a steel plate cut to size and electric arc welded to its threaded regulating shaft. The assembled gate is then inserted through the open bottom of the housing and the valve arc welded pressure tight. Welding equipment used was manufactured by The Lincoln Electric Company, also of Cleveland.

OXY-ACETYLENE PROCESSES IN IRON MINING*

There are several things about the development of the oxy-acetylene process in iron mining which are interesting. The first is, that while we can show that considerable progress has been made in the course of the last five years, we cannot substantiate this statement through a comparison of the oxygen and acetylene consumption of four or five years ago with the consumption of today. By actual check there is a very slight increase in the consumption of both gases over a period of four years.

If it had not been that new applications were started by the more aggressive mining companies, the present-day use of welding probably would be considerably less than what it was four years ago.

During the past five years considerable progress has been made by the iron mining companies towards modernizing their equipment. This has brought about quite a decrease in the number of men employed and has affected to some extent the business of some of the companies selling commodities which are used by the industry. Our industry has naturally been affected by this condition, as the modern and newly installed mining equipment has not required the repairs that would have been necessary had the old equipment been kept in use. As an illustration, the newer types of electric shovels with

**Reprinted from the Report of the Oxy-Acetylene Committee of the International Acetylene Association.*

increased bucket capacity replace from two to three of the old steam type shovels. This condition alone accounts for quite a decrease in the use of our products.

Another condition that is rather interesting is the present-day attitude of mining men towards the oxy-acetylene process. Briefly speaking, emergency reclamation applications have become so commonplace that they are no longer considered spectacular and very little is heard of them. Open pit iron mining is rather peculiar in that the actual mining operations are carried on only during the shipping season, beginning some time in April and ending some time during the month of October. During this period every piece of equipment is put into service so that schedules can be met. Very few mining companies have facilities for storage, and therefore the ore is loaded in cars in the mine and carried in these same cars directly to the ore docks. The storage capacity of these docks is limited, so it can be seen that the process of mine to boat is practically a continuous operation, and interference to this operation might hold up a boat for a day or more at considerable expense to the shipper.

It is very easy to see that a break-down on any piece of equipment during the rush season may cost the mining company thousands of dollars. Even though spare parts may be on hand, very often it is found that in order to install a new part the whole machine would have to be dismantled and assembled again, involving an expensive delay. In cases of this kind it is usually the practice of the mining companies to bring into use their oxy-acetylene equipment.

Some of the applications that we have record of where serious delays were avoided are as follows:

A broken collar on an armature would have delayed work at a washing plant for a week or more if it had not been possible to reclaim the part through bronze welding.

A driving sprocket which had worn was built up with nickel steel, giving it a life three times greater than a new sprocket, and resulting in the shovel's being in service the entire season without replacements.

A four thousand pound steam shovel side broke and was reclaimed during the mining season, avoiding a serious delay.

By welding the teeth on the main drive of a large steam shovel, this shovel was kept in continuous service, and another serious delay avoided.

A broken underground mine electric locomotive frame was reclaimed during the mining season and a saving to the mining company of very close to $1,800.00.

About the most spectacular use for the oxy-acetylene cutting blow-pipe during the past four years was when a number of men were entombed through a cave-in of a shaft in an underground mine. In order to reach these men it was necessary to cut away a lot of structural steel. Had it not been for the oxy-acetylene torch, the rescue work would have been delayed considerably.

A partial list of the present-day ore mining applications is given below. Many of these applications come under emergency repairs:

Steam Locomotives	Process Used For
Fire boxes	Weld—Construction and repairs
Tire flanges	Build up where worn
Boilers	Weld—Construction and repairs
Frames	Build up and repair with steel
Frames	Build up and repair with bronze
Cylinders	Weld—Repair bronze welding
Pistons	Build up and repair
Throttle stems	Build up where worn
Steam chest covers	Build up where worn
Electric Locomotives	
Frames	Build up and repair
Wheel flanges	Build up and repair
Shovels	
Booms	Repairs—New construction
Caterpillar pads	Build up and repair when broken
Caterpillar lugs	Build up and repair when broken
Buckets	Build up and repair when broken
Buckets	New construction
Boiler	Repairs—Construction
Fire boxes	Repairs—Construction
Throttle stems	Build up
Brake hanger posts	Build up—Repair
Demolition	
Locomotives	
Ore cars	
Shovels	
Rails	
Buildings	
Miscellneous	
Rail frogs	Build up where worn
Rail switches	Build up where worn
Rail bonding	Bonding
Rail ties, steel	New construction
Ore car journal boxes	Build up and repair
Ore car bolsters	Build up and repair
Ore car body supports	Build up and repair
Ore car body support guides	Build up and repair
Ore car dump cylinders	Repair
Ore car bolster parts	Repair
Ore car bed supports	Repair and build up
Ore car coupler parts	Repair and build up
Ore car air cylinders	Repair
Ore drills	Repair broken shanks
Dump plow parts	Repair—build up
Fan housings	Repair
Machine guards	New construction
Stellite	
Jack hammer drills	
Cyclone drills	
Scrapers	
Caterpillar pads and lugs	

PROPERTIES OF ARC WELDED STRUCTURES

By C. J. Holslag, Electric Arc Cutting and Welding Co., Newark, N. J.

In a recent issue *The Welding Engineer* published some pictures of full sized I-beams which had been welded to show that the resulting structure would stand more than the original beams, but the moral does not seem to be self-evident. The point on which I wish to comment particularly is that metallic arc welding is stiff and non-ductile and if this characteristic is used correctly the use of arc welding on structural work will progress more rapidly. A great many people take the lack of ductility of the electric weld metal to be a hindrance to its use and consider it as a problem which must be solved before the perfection of its use in various types of work is answered. As a matter of fact, where ductile arc welds are necessary they can be secured by using various kinds of covered electrodes or by using the gas bathed arc or by preheating. But for structural work and for most work on which electric welding is being used it is a

mistake to seek for a more ductile weld. If we carried this search for ductility to an extreme we would try to join two pieces of steel with a section of rubber to get the highest degree of elasticity and ductility.

Arc welded metal is a type of cast metal so that no matter whether it is made by hand or automatic methods it is sure to contain some of the characteristic defects of a casting such as are not apt to be present in a rolled or forged section. If the weld were too ductile such defects would soon allow the weld to break, whereas if the weld is stiffer and stronger than the parent metal such deformities would not cause breaks because the stresses would be taken up by the rolled or forged parent metal. In other words, it is an advantage in structural work to remember that the metallic arc deposit is stiffer than the ordinary parent metal. If the weld is anywhere near the proper dimensions it will not bend or stretch in service, but will compel the parent metal to do so and the parent metal is far better able to stand this service. Of course there are types of welds which should be ductile but these can be left to special methods such as the covered electrode and the gas bathed arc process.

Using the wrong kind of test procedure often results in an ill-advised prejudice against arc welding. It is not always a good test to machine the weld down to the size of the parent metal for testing, because this is apt to yield only a comparison between qualities of the weld deposit and the parent metal, whereas the most valuable test might probably be that of the complete structure.

In fact, the skin of the weld casting, which is the best part of the joint, is lost by this machining. Whenever possible it is a great deal better in my opinion to leave welds just as they are when making a test and thus get a good idea of what the whole assembly is good for. I can see no reason for cutting off the reinforcement when testing than for cutting the heads off rivets when testing a riveted assembly.

These considerations suggest that we should take advantage of arc welding as it is, and determine for what kinds of work its particular qualities make it desirable. It certainly is not good economy to withhold its use on one class of work because it does not show the quality which has been accepted as necessary on an entirely different type of structure. It is my belief that for the general run of structural work the quality of stiffness is highly desirable. If this is the case there certainly can be no advantage testing for ductility or in trying to find ways to put ductility into the welds made by this process for this type of construction.

NEW CROWN PRODUCTS

Crown Chemical Co., 885 East 134th St., New York City, affiliated with the Crown Aluminum Solder Company, makers for the past fifteen years of welding specialties, have placed on the market Crown Radiator Fix and Crown Boiler Fix.

Crown Radiator Fix is recommended for use in making welds on cast iron watertight. The troublesome problem of porous welds due to expansion cracks after weld is completed is successfully solved by use of this compound. It will repair cracked and leaky water jackets, motor heads, water pumps, leaky radiators, in fact, the entire water system.

In using this product it is necessary to have the radiator about three-quarters filled with water. Let the motor run until water is very hot, then pour contents of can into radiator and fill rest of radiator with water. This is all done while motor is running. The motor should be kept running until the leaks have all been stopped. This is usually accomplished in five to ten minutes. It is recommended, although not essential, that Crown Radiator Fix be poured in small vessel of hot water, stirred thoroughly then poured into raditaor. By using in this manner it shows quicker results particularly in unusually severe jobs.

Crown Radiator Fix is reported to be entirely different from any other compound on the market. It is composed of nine ingredients, including crushed aluminum. As the compound floats around the water the aluminum plates itself over and over, like a laminating job. In a few minutes a metal patch is formed.

Crown Radiator Fix will not clog radiator or line the wall of the cells as it only congeals where air is coming through under pressure, and the metal only plates where filler takes hold. Balance of compound floats through the entire system

Two of the Popular Crown Products.

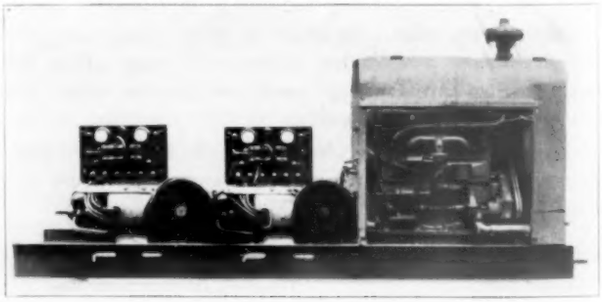
and should further leaks develop the filler will immediately repair them, although radiator can be drained and refilled with fresh water after leaks are stopped.

Crown Boiler Fix has already been used by the plumbing trade with great success for repairing cracked boiler sections. This compound will be of interest to welding shops that engage in repair of boilers.

After March 15, sole distributors to the welding trade, will be the Crown Aluminum Solder Co., 881 East 134 Street, New York City.

A NEW DEVELOPMENT IN ARC WELDING MACHINES

The Electric Arc Cutting and Welding Company, Newark, N. J., has placed on the market an arc welding machine which is made up of two "Dualarc" generators arranged in tandem and powered by a 40 horse-power Continental engine. Each of these



Dualarc Two—Operator Set.

generators is capable of supplying 300 amperes for metallic arc welding, or they can be multipled to obtain full capacity for carbon arc welding. The change here of course lies in the separate generators for supplying the current to two operators. The manufacturers claim that there is a saving of about one-half in the power and gasoline consumption for the two welding units.

C. M. TAYLOR IS NEW LINCOLN SALES MANAGER

The Lincoln Electric Company, Cleveland, Ohio, announce the appointment of Mr. C. M. Taylor, as Sales Manager.

Mr. Taylor graduated from Western Reserve University in 1916 and immediately entered the employ of The Lincoln Electric Company, and shortly thereafter was made Foreman of the Assembly and Test Departments.

In 1917 he enlisted in the United States Army for the duration of the war and spent two years in the United States Army Air Corps as an aviator.

Upon his return to The Lincoln Electric Company after the war, Mr. Taylor was made Time Study Demonstrator and Observer.

C. M. Taylor.

In 1923 he was promoted to Factory Manager and in 1925 was elected as Vice President of the Company.

Mr. Taylor remained as Factory Manager until his present appointment as Sales Manager.

ELKON OPENS DETROIT OFFICE

To more adequately serve industries in the Middle West, Elkon, Inc.—Division of P. R. Mallory & Co., Inc.—350 Madison Ave., New York City, announces the opening of their Elkonite Sales Office at 2842 West Grand Boulevard—the Curtis Building—Detroit, Michigan. J. A. Toleik and R. R. Tompkins will be the Resident Sales Engineers.

All sales on Elkonite Welding Dies and Electrodes in the Middle West will hereafter be handled through this Detroit office.

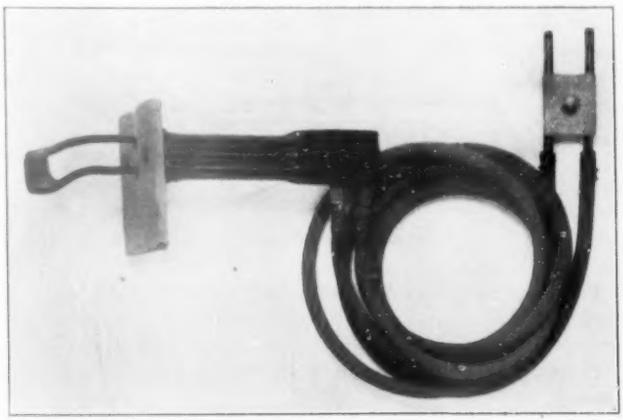
The opening of this branch office will be of special interest to the Automotive Industries, as, for the past two years, Elkonite has been used quite extensively in this field in many varied electric resistance welding applications.

NEW TYPE WATER COOLED CARBON ELECTRODE HOLDER

Announcement has recently been made by The Lincoln Electric Company, Cleveland, Ohio, of the production of an entirely new type water cooled carbon electrode holder for heavy duty manual welding by the carbon arc process. Designed primarily to insure greater comfort and less fatigue for the welder operator, it has been found after extensive tests in the manufacturer's plant that the new holder effects a marked economy in the use of the carbon electrodes, making it possible to weld with the arc tip of the carbon electrode projecting less than 3 inches from the carbon holder. Consequently there is less carbon area heated thereby greatly reducing the vaporization of the carbon. Thus it is possible to use smaller size carbons with higher current density which effects a decided saving in electrode costs.

The manufacturers state that innovations in design have made it possible to produce the new type holder at a weight of only 3¼ pounds in the welder operator's hand. In addition the holder is well balanced and easy to handle due to the flexibility of the lead cable.

One of the unique features, which contributes to the light weight of the holder, is the use of the hose which carries the water to also carry the cable to the holder. Each of the two water tubes contain a small light cable from the connector to the holder. The water flowing through the holder also acts as a cooling agent for the cables. By the use of this cooling agent the size cable to the holder is reduced. For example, if a standard cable were used, No. 000 would be necessary, while with the water cooling only two cables each equal in size to number 8 are used.



Lincoln Water-Cooled Carbon Electrode Holder.

The carbon holder consists of coiled copper tubing through which water constantly circulates, the carbon electrode being inserted through the coil. The carbon holders are manufactured in sizes for use with ¼ in., 5/16 in., ⅜ in., and ½ in. carbons. A hand shield of compressed magnesium protects the operator's hand from the arc rays. The water cooling system is incorporated also in the hand grip of the holder to keep it cool.

NEW AUTOMATIC AIR TORCH

The St. Paul Welding & Mfg. Company, St. Paul, Minn., is putting on the market an automatic torch for use with city gas and compressed air which embodies an entirely new idea in blow-pipe construction. Two valves, one for the city gas and one for the compressed air, are provided, and they are both operated simultaneously by hand lever. The city gas valve is so constructed that once the torch is lighted a small pilot continues to burn when lever control is released. With this arrangement the torch is put into operation with hand pressure on the lever which opens up both the city gas and compressed air. Releasing the lever closes the air valve and reduces the flow of city gas to just enough for the pilot light.

This new torch was gotten out especially for one of the large automobile manufacturers and it proved so successful that it is going to be offered wherever a torch of this kind can be used to advantage.

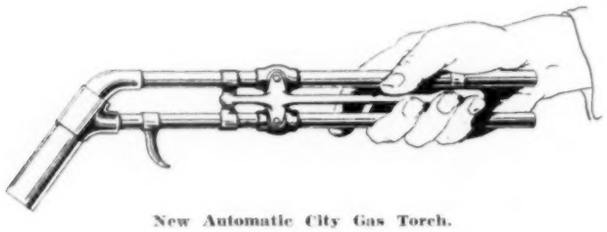
Reports on the actual use of the New Automatic Torch state that considerable savings of gas and time were shown as compared to that of torches previously used which required constant adjusting of the flame, or allowing the torch to burn between operations. With the new automatic torch, the flame is instantly off or on, eliminating all waste gas and time.

On touch-up work in auto body moulding the job was in the hands of the operator five minutes, while his torch

was used only 2½ minutes, thus showing a saving of 50% in gas and air.

On cowl-to-windshield touch-up work, requiring seven minutes, the torch is used twice for a total of three minutes. Here is shown a saving in gas and air of 55%.

Touch-up work on door sill plates requires about ten minutes, out of which the torch is used six minutes. The saving here is 40%.



New Automatic City Gas Torch.

Put to use on work in the foundry core room the new automatic torch is found very satisfactory for drying large cores which are made in part and afterwards cemented together.

In heat-treating of small tools the new torch also gives efficient service.

PREST-O-WELD MEDIUM-PRESSURE ACETYLENE GENERATOR

The Prest-O-Weld Type MP-101 Medium Pressure Acetylene Generator has been developed by the Oxweld Acetylene Company, 30 East 42nd Street, New York City, especially to meet the demand for a stationary or portable acetylene generator that can be used in connection with either medium-pressure or low-pressure welding and cutting blowpipes. This generator is adequate for any type of welding or cutting operation and can easily be carried from place to place on a truck or wagon.

Safety, dependability, sturdiness and minimum pressure fluctuation during operation were some of the requirements met in designing this generator. Its outstanding characteristic is rugged simplicity, but although simple in design, it incorporates several new features that insure satisfactory operation.

Heavy gauge material has been used in the construction of the generator and, where strength is required of the fittings, steel castings have been used. Bronze welding has been used for joining the generator shell and fittings. All parts are either galvanized or sherardized according to the conditions to which they are to be subjected.

The carbide valve is rotated by means of a spring clock motor which, in turn, is governed by an Oxweld diaphragm type motor feed control. This rotating feed valve is self-cleaning; the carbide brushes off any dust or lime deposit as it is fed. A pin in the stem above the valve prevents bridging of the carbide and consequent possible stoppage. There is nothing to get out of order in the carbide feed mechanism and it should never be necessary to remove the top for cleaning or other purposes.

Pressure adjustment is easily made by means of a thumb-screw on the motor feed control. The operation is very sensitive. Fluctuation during normal operation is less than 1 lb. per sq. in. and even under severe load the carbide feed is regulated to limit after-generation to a maximum increase of 1 lb. per sq. in. This close regulation permits operation of the generator close to the limit of 15 lb. per sq. in. without loss of gas through the relief valves when the blowpipes are turned off.

Should, by any chance, both the motor brake and relief valves fail to function, the motor locks at about 18 lb. per sq. in. pressure, thereby stopping the carbide feed. Should a broken mechanism which requires the valve to be lifted from its seat each time the generator is charged thus preventing the blow-off-line or leak of any kind cause the pressure to drop to zero during operation, the motor stops and will not start except by hand.

The motor is enclosed in a dust-tight housing. It is easily wound with permanently attached ratchet lever.

Time required for shutting down the generator, flushing and refilling with carbide and water is about 15 minutes. Relief valves are opened by raising an interference rod to vent the air-gas mixture after refilling so that it is unnecessary to vent hose or pipe lines connected to the generator.

The feed valve cone can be raised to seal the hopper when the generator is being moved. This valve is also automatically raised, closing the hopper, every time the carbide filling door is opened. The hopper and generator body are so designed that no water will enter the hopper in case the generator is knocked over. The agitator, used to facilitate the draining off of residue, is of the same type which has proved entirely satisfactory on Oxweld Duplex Balance Seal generators.

The hydraulic back pressure valve and filter are contained in a seamless drawn shell with a flange cover and outlet casting, bronze-welded to the shell. The cover can be removed for repacking the filter, when necessary, by removing eight cap screws.

Prest-O-Weld Type MP-101 Medium Pressure Acetylene Generator.

An interference rod permits opening the water filling cock only while the relief valves are open. The hydraulic back pressure valve is automatically drained and refilled every time the generator water is changed.

The Underwriters' Laboratories have permitted a double rating for the M.P.-101 generator making its rated capacity 60 cu. ft. per hour, which is ample for almost any welding or cutting operation.

The carbide capacity of this generator is 30 lb. and the quarter size (¼ x ½-in.) carbide is used. A special funnel, which is

held in place on top of the generator, is provided for filling the generator with carbide. The generator is painted in a pleasing color combination; the body is gray, all acetylene pipes are red, and all water pipes are black. The overall dimensions of the generator are: Height, 60 in., and width, 34 in. The weight of the generator empty is 305 lb. With a full charge of carbide and water, the total weight of the generator is 623 lb. The weight of the generator crated for shipment is about 455 lb. The generator can be inclined to an angle of 30 deg. from the perpendicular without tipping.

WELDING SUPPLY EXHIBITS DRAW ATTENTION AT N. R. A. A. AND A. R. E. A. SHOWS

The displays of welding equipment and supplies attracted interest as usual at the exhibition of the National Railway Appliances Association and American Railway Engineering Association. The following manufacturers exhibited their products: Air Reduction Sales Co., American Brass Company, American Rolling Mill Co., American Steel & Wire Co., Electric Railway Improvement Co., Electric Railweld Service Corp., General Electric Co., Metal & Thermit Corporation, Metalweld, Incorporated, National Carbon Co., Ohio Brass Co., Oxweld Railroad Service Co., Page Steel & Wire Co., The Rail Joint Company, Torchweld Equipment Company, Westinghouse Electric & Mfg. Co.

"LIGHTNING" ELECTRODE ANNOUNCED BY HOLLUP

The C. H. Hollup Corporation, Chicago, Ill., have developed a welding rod which is announced as a distinct improvement so far as speed, penetration and ductility are concerned. The speed at which this electrode works is claimed to be nearly double, and for certain work more than double, the regular welding speed of ordinary rods.

Another point of importance, according to the makers, is the ease with which this rod can be handled by the most inexperienced operator. To hold a steady arc, without interruption, is

Fig. 1. Bending Test of Welds Made With Hollup "Lightning" Electrode.

most desirable in any weld and for a beginner at arc welding, or an operator with an unsteady hand, it is often hard to maintain a continuous arc. This new welding electrode carries a higher voltage (30 to 35 volts) across the arc, which accounts for the ease of manipulation. It is also due to this higher force that the penetration is remarkably deep. It is only natural if you force more heat through a given size wire, with a higher voltage, that the melting rate of the wire must be greater, therefore a higher speed in welding.

The coating of this new electrode is compounded of materials that will be consumed at the same rate as the wire is melted. This coating gives off combustible gases, which will burn around the arc, and prevent the atmosphere from getting at the molten metal while it is in transit from the rod to the work and also from the molten puddle itself, until this has chilled sufficiently and is no more affected by the air. The molten metal, having no chance of absorbing oxygen and nitrogen, while in an overheated condition, will result in a clean and ductile metal, free from impurities.

Accompanying photographs show a flat bar iron on which a deposit of metal has been made with this new Lightning Rod.

The samples in Fig. 1 are made of $\frac{3}{8}$" x $1\frac{1}{4}$" flat iron and after the welds had been made were bent "U" shape so as to stretch the welded deposit without showing a fracture. Fig. 2

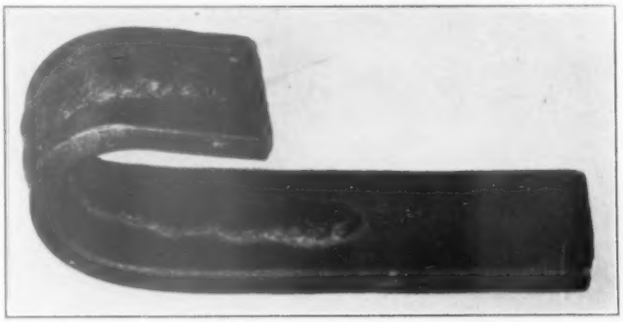


Fig. 2. Bending Test Illustrating Penetration As Well As Ductility.

shows the possible penetration with the $\frac{1}{8}$" Lightning Rods. It can plainly be seen on the back of this piece that the welding heat went clear through the $\frac{1}{4}$" thickness of metal.

The appearance of a weld made with this new welding rod is very much like an acetylene weld. It has a smooth surface finish and does not show the usual wavy ridges. This is due to the speed at which this rod works, leaving a larger molten section behind.

This welding rod had been in the experimental stage for about fourteen months, developed in the Research Department of the C. H. Hollup Corporation and is now on a production basis.

ELECTRODE HOLDER WITH VENTILATED HANDLE.

A new type of electrode holder has been developed by E. A. Key Company, Los Angeles, Calif., embodying some features which, the manufacturers claim, give this holder such advantages as long life, no heating up to 300 amperes, positive vice grip, no arcing on uncoated rod, non-slipping, self-cooling handle, and no springs.

PROBLEMS OF WELDING MONEL METAL AND NICKEL

The International Nickel Co. has been publishing a series of articles on the problems of welding Monel metal and nickel. The first was covered in Vol. VIII, No. 2 of *Inco*, the publication of that company, and gives a comparison of Monel metal and nickel with recommendations on oxy-acetylene welding and fluxing. The second of the series appears in Vol. VIII, No. 3, and includes many valuable suggestions. Copies of these articles can be obtained by addressing the editor of *Inco*, The International Nickel Co., New York City.

OXWELD ANNOUNCES NO. 21 HIGH STRENGTH BRONZE WELDING ROD

An improved bronze welding rod, designated Oxweld No. 21 High Strength Bronze Welding Rod, has been placed on the market by Oxweld Acetylene Company, 30 East 42nd Street, New York City. This rod is recommended for all bronze welding applications including the fusion welding of brass and bronze,

bronze-welding of malleable and gray iron castings, joining dissimilar metals and building up bearings and other wearing surfaces. The claims made for it are that due to its composition it has a uniformly low melting point and easily controlled flow; it produces a weld metal as hard and wear resistant as that formerly made with manganese-bronze rod, and that by its use, tough and ductile weld metal having a tensile strength of over 45,000 lbs. per sq. in. can be produced.

Properties of this rod are said to eliminate almost all boiling and fuming of the weld metal. Annoying fumes are reduced to a minimum and elimination of oxide and gas inclusions is a

Pipe Joint Made With Oxweld No. 21 High Strength Bronze Welding Rod.

reason for both the remarkably sound and strong weld metal produced and the better adhesion to iron and steel.

This new bronze welding rod has been thoroughly tested in the laboratory and in the field. It is believed that it will greatly widen the already broad scope of the most versatile of all the oxy-acetylene operations, bronze-welding.

NEW DEVELOPMENTS IN SIGHT FEED ACETYLENE GENERATORS

The Sight Feed Generator Co. of West Alexandria, Ohio, has recently issued a bulletin describing their new type "P" portable acetylene generators. These are being manufactured in four sizes designated by their carbide capacities as the 12 lb., 25 lb., 50 lb., and 100 lb. and have all been approved by the Underwriters' Laboratories. As in the previous machines made by this company, these new generators have the Pyrex glass carbide hopper which permits the user to see exactly how much potential gas he has on hand before starting a job, and how much he has used after he is through. The carbide feed apparatus is also the same as that used in all other generators previously manufactured by the Sight Feed Generator Co. As described in the bulletin, this consists of having the upper end of the hopper closed by a diaphragm having a coiled spring pressing on the top side and supporting a free swinging steel rod on the lower side, the rod having a circular groove near its lower end. When this feed-rod is released the groove passes through a circular hole in the bottom of the hopper permitting a few granules of carbide to fall into the water, thus making the acetylene. The pressure of the gas against the diaphragm maintains the groove in the feeding position without variation while the generator is in use. Upon shutting off the torch the pressure automatically raises the diaphragm and feed rod, stopping the feed of the carbide to the water.

The new developments consist of the improved flash back check which has a removable ball check under water, and also removable filters giving a washed and filtered gas. An improvement in the automatic blow-off-valve is found in an interference valve from becoming sludged and stuck shut. Another feature is that the sludge pipe is welded into the very lowest part of the belled down bottom so that all the sludge drains out at each emptying.

As these generators were designed with portability in mind, they are claimed to be very easy to handle. The 12 lb. size weighs 168 lbs. fully charged with carbide and water. The 25 lb. size weighs 314 lbs. fully charged. Both the 12 and the 25 lb. sizes are of about the same height which is 4 ft. 3 in.,

Sight Feed Portable Acetylene Generator.

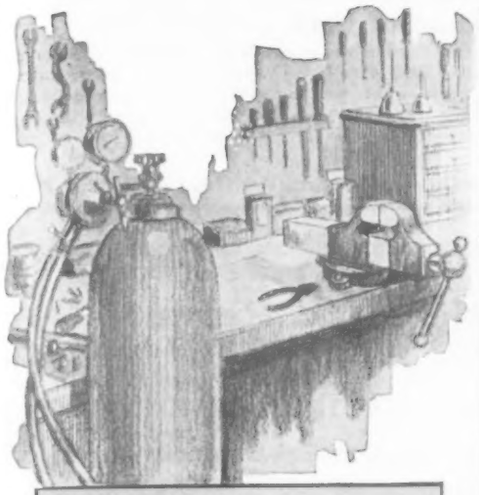
and they are both under twenty inches in diameter. Either generator mounted on the special truck shown in the picture can be moved by one man over all ordinary obstructions such as railroad tracks and street curbs.

NEW PAMPHLET ON ARC-WELDING IN BUILDING CONSTRUCTION

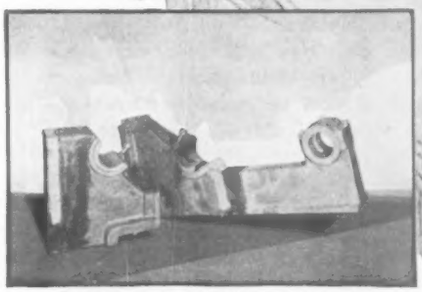
An article entitled "Suggested Designs for Arc-Welded Connections in Building Construction" prepared by J. F. Lincoln has been printed as an eight page pamphlet and sent out by The Lincoln Electric Co. of Cleveland, Ohio. This paper contains many valuable suggestions regarding the arc welding of structural steel, and also a number of very interesting detail drawings depicting just how these arc welded connections can be made. Of special interest are the numerous methods suggested for making field connections of various types without the use of bolts or clamps.

STOODY WILL SELL VICTOR EQUIPMENT IN SOUTHERN CALIFORNIA

Announcement has been received that the Stoody Company, Whittier, California, has been appointed factory representatives of the Victor Welding Equipment Company of San Francisco and will handle the complete Victor line of welding and cutting equipment in that territory.



Fractured casting prepared for welding.



Castings completely Tobin Bronze welded on the same day that the break occurred.

Welding with TOBIN BRONZE* *saved 9 days*

THE castings illustrated were repair-welded with Tobin Bronze and returned to service on the same day that they were broken, at a fraction of the cost of new parts. A similar break on a former occasion tied up the machine for ten days, until new castings could be made and delivered.

This is a typical instance of the way Tobin Bronze Welding saves time and money. Due to the low welding temperature required—1650° F.—pre-heating is usually unnecessary, which means less time and less gas. It also means that many repairs can be made in place without dismantling and reassembling. And Tobin Bronze Welds, properly made on cast-iron, are stronger than the casting itself.

Tobin Bronze is preferred by experienced welders because of its combined high strength, ductility and uniform composition. A sample rod for testing will be furnished to welders upon request.

*Trade-mark reg. in U. S. Pat. Off. and Canada

There is a suitable Anaconda Filler Rod for every welding purpose. The principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze	1650°F
Manganese Bronze	1598°F
Brazing Metal	1634°F
Electrolytic Copper	1981°F
A. B. Naval	1625°F
Everdur	1866°F
Ambrac	2102°F

for arc welding

Phosphor Bronze	1922°F
Everdur	1866°F
Ambrac	2102°F

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Our costs are considerably under those of large industrial centers; ours is a one-profit wire sold direct to user from our own mills exclusively devoted to making of welding wire from raw material to finished product—hence our extremely low prices for wire that is definitely superior. Adopted exclusively by many large users.

Prices on request.

A grade for each type of work—send for samples. Standard Steel & Wire Co., Greensburg, Pa. (Mills at Bolivar, Pa.)

PAMPHLET ON PRESSURE VESSEL WELDING

The Linde Air Products Company, 30 East 42nd Street, New York City, has recently issued an eight page booklet on the subject of "Oxwelding Pressure Vessels." The text of this booklet is in effect a reprint of an article which appeared in a recent issue of their monthly publication "Oxy-Acetylene Tips." The major portion of it is devoted to a procedure control for welding on pressure vessels. That is, it tells how to determine the ability and knowledge of welding operators, how to select material of good welding quality, how to design the vessel correctly and how to design the joints properly for welding, how to prepare the material for welding. Then it outlines the proper procedure to follow on this class of work and tells how satisfactory tests may be made on the completed vessel. The booklet concludes with a description of a number of important welded pressure vessels to indicate what has been accomplished by using procedure control in this field.

SIEGER WILL SPEAK IN CHICAGO ON CARBOLOY

At the regular monthly meeting of the Chicago section of the American Society of Mechanical Engineers, which will be held in the Engineering Building, 205 Wacker Drive, Chicago, on Monday evening, March 18th, Mr. G. N. Sieger and Mr. E. G. Gilson of the Carboloy Company, will speak on the commercial status of Carboloy; its characteristics, capabilities and limits. Carboloy is a tungsten carbide compound which has recently been developed and has attracted considerable attention on account of its merits as a material for machine tools. Some very interesting work has been done with it in machining cast iron and it is said to offer some good possibilities in the welding field on account of its use in machining castings which contain hard areas due to welding.

NEW ENGLAND WELDING FIRM HAS INCORPORATED

An announcement has been received telling of the organizing of The Manchester Engineering and Welding Co., Incorporated, 449 Hayward St., Manchester, N. H. This company was formed around the business previously conducted by Mr. Paul B. Covey, who has become the president of the new concern. The corporation was formed to carry on three principal lines of work—first, structural steel design; second, fabrication of structural steel and ornamental iron work; and third, general repair work. Most of this work will be done by arc welding, with which process they have already had several years of successful experience, among other things having designed and erected a factory building 60 ft. wide by 200 ft. long containing 90 tons of steel. They expect their business to cover a territory composed of the states of Vermont, New Hampshire, and Maine.

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Arc, Spot, Butt Welders
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For Sale—One Weldrite Welder, suitable for operation on either 220 or 440 volts, 60 cycle. Guaranteed good as new and can be seen in operation. Price $250.00. The Modern Machine Shop, Inc., 123 N. Hazel St., Danville, Ill.

MASTER METAL ALUMINUM SOLDER

For repairing castings and sheets on Auto, Bus, Truck, Aviation and Pattern work. Has toughness, strength and hardness. Work at 350 degrees—eliminates preheating, expansion and warping troubles. $3.50 per pound. Satisfaction guaranteed. Dept. AS-7, Reynolds Metals Company, Inc., Louisville, Ky.

Assistant Operator Wanted for liquid oxygen plant of large copper company in Chile, South America. Applicant must have mechanical experience and secured his training in gaseous or liquid oxygen plants. Good working and living conditions, three year contract, all traveling expenses paid. Give full details of your qualifications in letter. Address "A. Y." P. O. Box 822, City Hall Station, New York City.

Position Wanted—Welder with several years experience in handling all metals and alloys wants to make a good connection in the aircraft industry. Offers unusual knowledge of welding. Address Box 175, care of The Welding Engineer.

Position Wanted—Progressive young man wants an opportunity to learn either or both gas and electric welding. Single. Will go anywhere any time. Address Box 174 care of The Welding Engineer.

Wanted—A live wire to take an interest in a chain of welding shops and supply depots. A wonderful opportunity for the right man. Address Box 176, care of The Welding Engineer.

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MANGANESE STEEL WELDING WIRE $\frac{1}{8}$" to $\frac{5}{16}$" dia.
STOCK SHIPMENTS

The premier rod for the repair, or building up of worn Manganese Steel Track-work and other castings requiring a hard tough surface. Manufactured by the makers of Tisco Manganese Steel; the first in America to produce this remarkable metal.

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Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

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Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

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BRANCHES:

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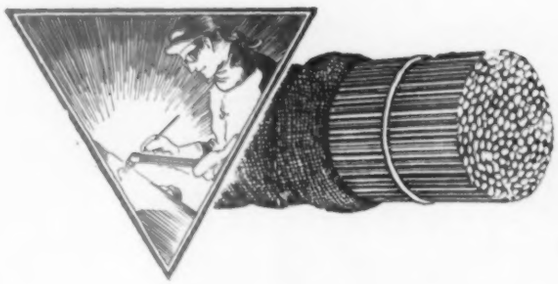
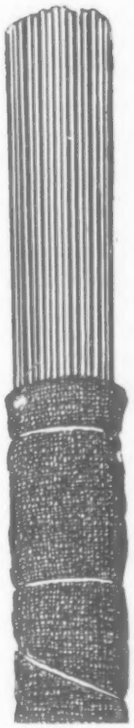
708 Thrower Bldg. Atlanta, Ga.
683 Atlantic Ave. Boston, Mass.
417 Market Street San Francisco, Calif.



penetration ductility strength

IN gas and electric welding these three factors are pre-eminent. Welding Rods that possess them can be classed as super-quality. WISSCO Rods—which are pre-tested for quality and uniformity—are such rods.



They penetrate deeply due to quick melting and free flowing. Being free from impurities no hard spots or pores result. The finished job has the strength of the metals welded—often greater.

Each grade of WISSCO Rods is of special composition for a specific type of welding. All grades are carried in stock to prevent delay in deliveries.

Wickwire Spencer Welding Engineers will prescribe the rod or wire that will do your job better. They will show you how to practice peak economy and insure uniformly good results.

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Buffalo Cleveland Chicago Atlanta San Francisco Los Angeles Worcester

WISSCO *WELDING RODS*

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OXY-ACETYLENE *Welding and Cutting Equipment*

Hundreds of thousands of dollars are being saved in factories, foundries and metal working plants through the use of Imperial Welding and Cutting Equipment.

Broken parts—from the smallest to the largest—are repaired at a fraction of the cost of new parts. Imperfect castings are saved from the scrap heap. Gates and risers are cut from castings at lower cost and greater speed than by any other method.

And more and more, Imperial Oxy-Acetylene Welding and Cutting Torches—now durably chromium plated—are being used in production operations, increasing output and reducing costs.

Surely there are operations in your plant that could be done better, quicker and more economically with Imperial Welding or Cutting Equipment than by the method you are now using. Our engineers are not merely welding experts—they know production and maintenance as well. Let them tell you frankly whether or not you can profitably use Imperial Equipment. A letter to us entails no obligation.

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"...this rod cut costs 60%"

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ERIE, PENN.

Page Steel & Wire Company,
Union Trust Company,
Pittsburgh, Pa.

March 10

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Attention Mr. S. R. Hawkins, Jr.

Subject: Page-Armco Welding Rods

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The use of this rod has enabled us to cut the cost of repairs or rewelds on leaky containers, approximately 60%. We will be pleased to recommend this wire to anyone wishing to secure rods of the highest quality

Very truly yours,
SHEET METAL PRODUCTS COMPANY

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YOU can prove Page Welding Wire economy for yourself. Samples furnished on request.

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District Offices:
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Canadian Distributor and Manufacturer: Frost Steel and Wire Co., *Limited*, Hamilton, Ontario

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Welding Wire and Electrodes

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National Carbide have been pioneers in

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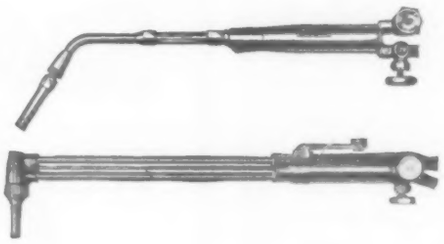

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PASSAIC-BERGEN WELDING WORKS,
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SUTTON-GARTEN CO.,
217 W. 10th St., Indianapolis, Ind.

E. BRASS AUTO SUPPLY CO., INC.,
307 Burnet St., New Brunswick, N. J.

WELDING & SUPPLIES CO.,
3445 Parthenais St., Montreal, Canada

CHICAGO GRINDING & MACHINE CO.,
2117 Tilden St., Chicago, Ill.

SIGHT FEED GENERATOR CO.,
W. Alexandria, Ohio.

CHAS. E. EBRIGHT,
2612 Terrace Ave., Columbus, Ohio

FRANK MILLNER COMPANY,
102 N. Olden Ave., Trenton, N. J.

SPRAGUE SERVICE & SUPPLY CO.,
276 Davidson Ave., Perth Amboy, N. J.

STORTS WELDING COMPANY,
44 S. Colony St., Meriden, Conn.

WILLIAM McCARTHY,
308 James St., Syracuse, N. Y.

GEO. E. TEMPLE COMPANY,
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JOHN W. EVANS,
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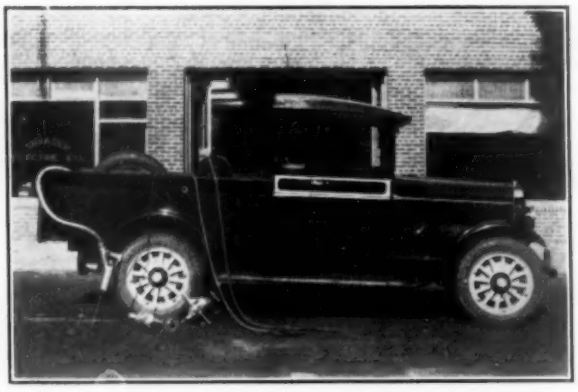
SHRADER

PORTABLE ARC WELDER



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The smooth arc is easily controlled and of great penetration producing a weld that is strong and ductile.

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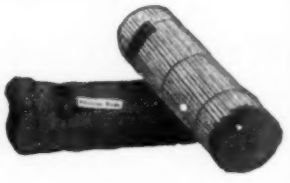

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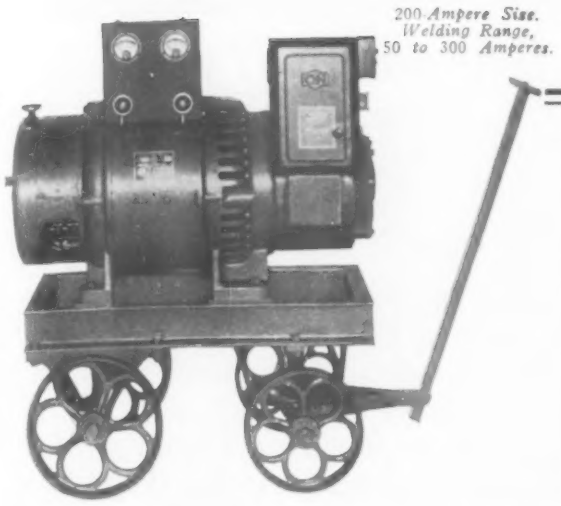

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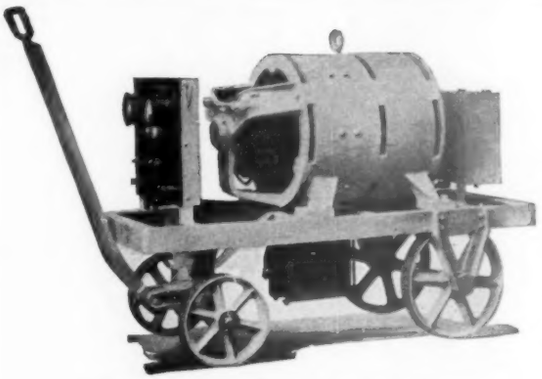

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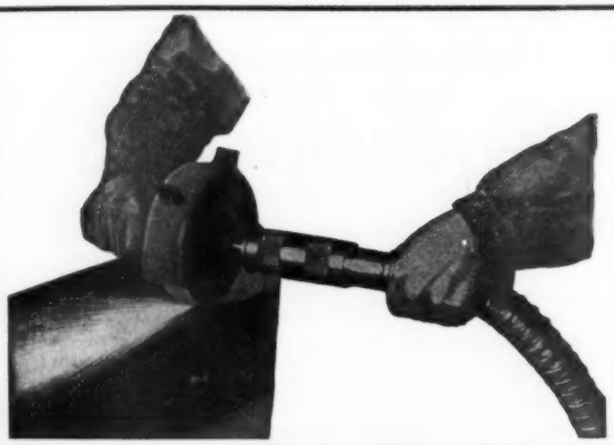

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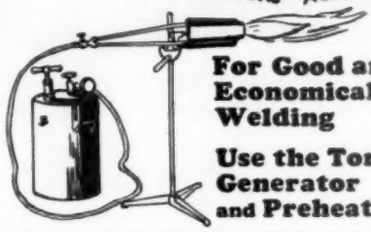

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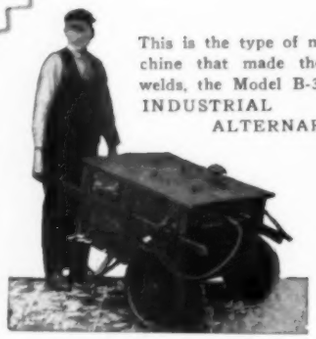
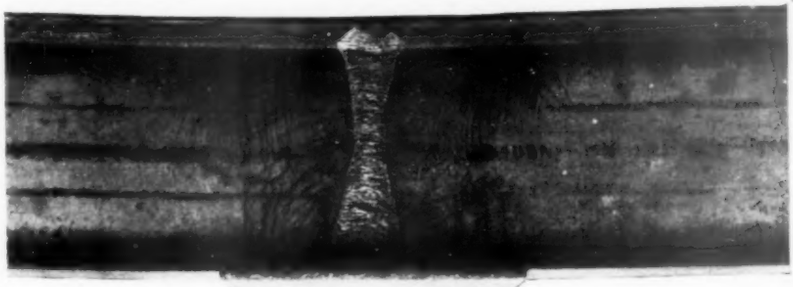
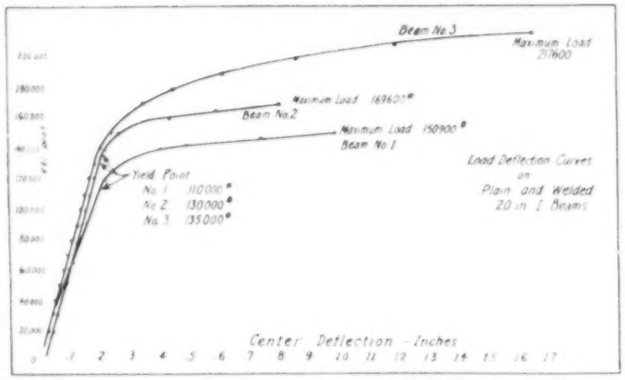


This is the type of machine that made these welds, the Model B-300 INDUSTRIAL ALTERNARC

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